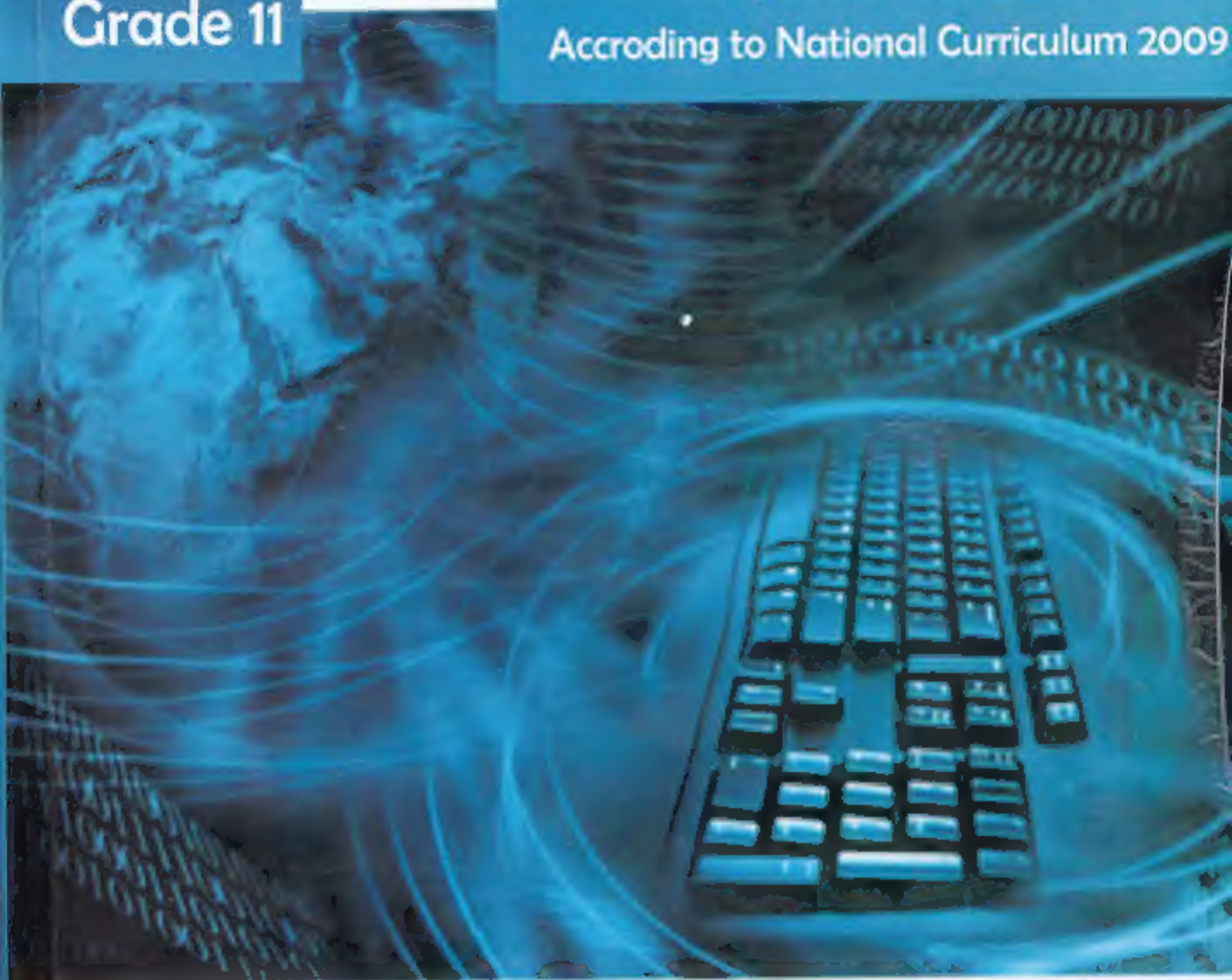


**F.M SERIES**

# **FUNDAMENTALS OF COMPUTER & DATA BASE CONCEPTS**

**Grade 11**

**Study Book for Computer Science  
Accroding to National Curriculum 2009**



**Sheikh Faisal Manzoor**

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# F.M SERIES.

## FUNDAMENTALS OF COMPUTER & DATABASE

For GRADE 11

According to the syllabus of Federal & Balochistan Board.

Written By

Sheikh Faisal Manzoor  
Head of Computer Science Dept:  
FG Degree College Quetta Cantt



Asim Asghar ✓  
Asghar Ali ✓

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8. Muhammad Arsalan, Lecturer (Computer Science), Govt Gen Musa College Quetta.
9. Mr. Rashid Ahmed, Lecturer (Computer Science), Govt Girls Degree College Quwary road Quetta.
10. Mr. Usama Saeed, Lecturer (Computer Science), Islamia Boys College Quetta.
11. Mr. Khizar, Lecturer (Computer Science) Govt Gen Musa College Quetta.
12. Mr. Abdullah, Lecturer (Computer Science), FG Girls Degree College Quetta.

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## PREFACE

Computer knowledge like all scientific knowledge has maintained its importance in this modern age because of its utility in every day dealings. This branch of knowledge has shown its impact on almost all modern fields of research.

I thank Almighty God, who has given me ability to frame this study book to help the students of XI year studying Computer Science. It is in accordance with the latest National Curriculum for Computer Science (2009).

I have framed this book with sheer sincerity and utmost effort to help the students in achieving their objectives. I have tried to put the matter in an easy language. An important feature of this Study Guide is that it covers every topic including Overview of Computer System, Computer Memory, Central Processing Unit, Inside System Unit, Network Communication and Protocol, Wireless Communication, Database Fundamentals and Database Development. MCQs at the end of every chapter and important abbreviations at the end have been given for further guidance. Following sources and books are consulted for the preparation and compilation of this guide.

- Introduction to Computers by Peter Norton
- Computer Fundamentals by PK Sinha
- MCSE Networking Essentials
- Internet

I do hope this study guide will equip the students with a wide range of computer knowledge and win favour and admiration from the students. Any suggestion for its further improvement is however invited.

**FAISAL MANZOOR™**

Head of Computer Science Dept: F.G Degree College Quetta Cantt

Ex-LAN Administrator SBK Women's University Quetta.

Test Administration Staff in National Testing Service of Pakistan.

Exhibiter in ITCN Asia 2004

e-mail: [misterfaisal@hotmail.com](mailto:misterfaisal@hotmail.com), [misterfaisal.fg@gmail.com](mailto:misterfaisal.fg@gmail.com)

Face Book ID: Sheikh Faisal Manzoor Cell: 03337926605

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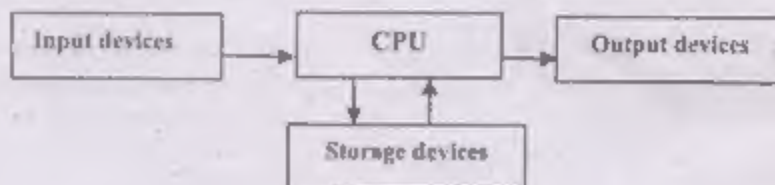


## UNIT 1

### OVERVIEW OF COMPUTER SYSTEM

#### 1.1- INTRODUCTION TO COMPUTER

Computer is an electronic device which takes data (as input), performs operations (as processing) on that data and gives the results (as output) according to the given input. A computer is an electronic machine used to solve different problems according to a set of instructions given to it. A simple computer is composed of input devices, the central processing unit, output devices, primary / secondary storage devices and communication devices.



A Simple Computer System

#### Advantages / Characteristics of Computer

- 1- A computer is used to solve problems for people by carrying out instructions given to it.
- 2- We can permanently store huge amount of data in storage medium of computer i.e. hard disk, compact disc etc, which can be used and modified in future.
- 3- Computer is a fast computing device, it can perform various operations within a second, which a human being do in many hours. It can be used to solve different problems very quickly.
- 4- The accuracy of computer is consistently high and the degree of accuracy of a particular computer depends upon its design. Errors can be occurred but they are mainly due to human rather than technological weakness, for example if the input data is incorrect, the resulting output will also be incorrect. In computer terminology it is known as Garbage in Garbage out (GIGO).
- 5- As computer is a versatile machine, therefore we can perform different tasks one by one or simultaneously on computer.

#### 1.1.1- COMPUTING DEVICES

A machine, component or device that contains embedded<sup>1</sup> computer is known as computing device. A computing device performs special computing tasks for example the computer in ATM performs different banking transactions. The computer in smart phone allows the user to perform different tasks like browsing the web and sending

emails etc. Some of the computing devices are ATM (Automated Teller Machine), Digital Washing Machine, Digital Microwave Oven, and Smartphones etc.

### 1.1.2- BASIC OPERATIONS PERFORMED BY COMPUTER

Any computer system performs the following basic operations regardless of its size, storage and processing capabilities.

**i- Input Operation:** Any data or instruction entering into computer is called input operation. Computer can accept data by means of devices such as keyboard, mouse etc. known as input devices.

**ii- Processing Operation:** Computer performs arithmetic and logical operations on the accepted data. Arithmetic operation includes addition, subtraction, multiplication and division whereas logical operations are comparison of different values.

**iii- Output Operation:** After processing the data, computer produces useful information by sending the result to output device such as monitor, printer etc.

**iv- Storage Operation:** Computer can store the results of processed data for future use. Writing data to storage devices like hard disk, USB flash drive etc. is said to be a storage operation.

### 1.1.3- CLASSIFICATION OF DIGITAL COMPUTER

Computers are classified into four types in terms of speed, storage, size and cost as follows:

i- Super Computer ii- Mainframe Computer iii- Mini Computer iv- Microcomputer

#### i- Super Computer

Computers that are the fastest and most expensive of the running time can be called as super computers. They have extra ordinary amount of computing power required to perform complex tasks by large organizations. Following are the application areas where supercomputers are used:

- 1) In designing and controlling of rockets.
- 2) In designing and controlling of fighter planes.
- 3) In weather forecasting, weapon designing and atomic research.



Super Computer

The modern supercomputer consists of thousands of microprocessors. It can process trillions of instructions per second. It has very large storage capacity and can store several thousand times more data than a desktop computer. It is also used in many organizations like Pakistan Atomic Research Centre and SUPARCO (Space and



Upper Atmosphere Research Commission). Roadrunner, Blue Gene, and Deep Blue are some of the supercomputers manufactured by Cray Inc. and IBM.

## ii- Mainframe Computer

These computers are large-scale computers together with their supporting equipment with a very high cost. Computer systems of this size can accommodate a large room. Mainframes are usually used in networking environment where thousands of computers and peripheral devices are connected with it. A Mainframe computer can store large amount of data. It can execute about trillions of instructions per second (TIPS). HP 16500 series, HP Superdome, EC 12, and EC 196 are examples of mainframe computers.



Mainframe Computer

Following are the application areas where Mainframe computers are used:

- 1) In large organizations like banks
- 2) In Universities
- 3) In scientific laboratories etc.

## iii- Mini Computer

These are the medium power computers, more powerful than microcomputers but less powerful than mainframe computers. They are also known as mid-range servers. Moreover they are low cost computers as compare to super and mainframes. These computers are used by private organizations that do not afford to buy super or mainframe computers. These computers can execute billions of instructions per second (BIPS). Hundreds of computer can be connected to the mini computer. The difference of microcomputer and minicomputer is decreasing due to advancement in the technology. IBM System/36 and HP 3000 are examples of minicomputer.



Mini Computer

## iv- Micro Computer

Micro computers are relatively small and inexpensive computers that are rapidly being used in almost every field of life such as at home for personal use as well as in different organizations for business. It is also called personal computer. The small size of microcomputer is a result of the technologies known as LSI (Large Scale Integration) and VLSI (Very Large Scale Integration) that made it possible to put tens of thousands of transistors on



Micro Computer

can execute millions of instructions per second (MIPS). It is available in different sizes and shapes such as desktop and laptop etc. IBM ThinkPad, Toshiba Satellite series and Apple computers are commonly used microcomputers.

### 1.1.4- MODERN USE OF COMPUTERS IN TODAY'S LIFE

#### Mobile Computing

Mobile computing is the technology that allows the user to access the data and information from anywhere using wireless network system. Mobile computing devices run on batteries and have limited functions. Tablet PCs, PDAs (Personal Digital Assistants) and smart phones are the examples of mobile computing devices.

#### Internet of Things (IoT)

Internet of Things is the interconnection between computer network and physical devices such as vehicles, home appliances, and other items. These devices are embedded with software, sensors, cameras, microphones and network connectivity that enable these devices to connect and exchange data.

Smart home is a popular application of IoT. There are homes equipped with various types of devices that can be controlled remotely with smart phone or computer through IoT system. For example IoT allows us to switch on air conditioning before reaching home or switch off lights after leaving home.

#### Cloud Computing

Cloud computing is a term that applies to applications and data storage delivered over the internet. Cloud computing means instead of buying and installing your own computer system and software at your workplace, you can get it as a service over the internet. The users don't need to know where the hardware and software is located. It is just somewhere in the "cloud".



#### Advantages

- 1- We don't have to buy and maintain a complex computer system so the cost is reduced.
- 2- It cuts cost of buying computers and peripherals.
- 3- We don't need to worry about the outdated equipment and other problems related to security and reliability.

#### Disadvantages

- 1- It requires high speed internet connection.
- 2- Privacy and security risk is there of having a valuable data on someone else's system in an unknown location.



### **Data Center**

Data center is a centralized place to store, manage, process and distribute data. It consists of servers, routers, switches, firewalls and backup devices. A data center usually requires air conditioning, fire suppression, smoke detection and security entry. Data centers are typically used by large organizations such as government agencies, banks, telecom companies and social network providers.

### **1.1.5- COMPUTER HARDWARE AND SOFTWARE**

There are two main parts of a computer systems i.e hardware and software

#### **Hardware**

The touchable parts of computer are known as hardware. All physical components of the system such as keyboard, mouse, monitor, printer, along with the circuitry that connects them are known as hardware.

#### **Software**

Set of instructions that tells the computer what to do and how to do. A computer works according to the instructions written in the software, these instructions are known as program. Different softwares are used to solve different problems and to perform different tasks. For example software for creating documents such as MS Word, software for graphics such as Adobe Photoshop and software for managing computer such as MS-Windows etc.

### **1.2- TYPES OF SOFTWARE**

Computer software can be categorized into following types:

- **System Software**
- **Application Software**
- **Internet Applications**
- **Licensed software, Open Source Software, Shareware and Freeware**

#### **1.2.1- SYSTEM SOFTWARE**

System software consists of programs that controls the computer hardware and make the use of computer more effective. A computer without some kind of system software would be ineffective and impossible to operate. Following are some of the examples of system software:

- |                           |                      |
|---------------------------|----------------------|
| i) Operating System       | ii) Utility Software |
| iii) Language translators | iv) Device Drivers   |

##### **i- Operating System**

An Operating System is a type of system software that is used to manage various resources such as CPU, storage devices, and all I/O devices. There must be at least one operating system installed in a computer to support all the activities of a

computer. Microsoft Windows, Linux, UNIX and Mac OS are some of the examples of Operating System.

### **Task Performed by Operating System**

- 1- It provides the user interface i.e. GUI (Graphical User Interface) or CLI (Command Line Interface).
- 2- It allocates system resources such as CPU and memory etc.
- 3- It loads program into memory and executes them.
- 4- It controls the operations of all the I/O devices.
- 5- It manages files and folders.
- 6- It maintains the security of the computer.
- 7- It controls network operations.

### **ii- Device Driver**

Device Driver is a type of system software that controls the operation of a device. The device drivers are provided by the device manufacturer. All devices attached to the computer need the device driver such as printer, modem and sound card etc. Many drivers for plug n play devices such as mouse, keyboard and monitor etc, are pre-installed in Windows.

### **iii- Utility Software**

Utility software provides additional facilities to carry out tasks related to the effective management of a computer system. The user can use a utility program to perform maintenance task related to hardware or software. Disk defragmenter, File compressor, Antivirus software and Disk cleaner are some of the examples of utility programs.

### **iv- Language Translators / Processors**

Language translator is a type of system software that is used to convert the source code into machine code and make the computer capable to understand the instructions because a program written by a programmer in Assembly language or any high level language that is known as a source program is not directly understandable by the computer. There are three types of Language translators as follows.

- **Assembler:** Assembler translates assembly language instructions into machine codes.
- **Compiler:** Compiler translates the entire program at once into machine language before the execution of program.
- **Interpreter:** Interpreter translates the program into machine code line by line or one instruction at a time.



### 1.2.2- APPLICATION SOFTWARE

Application software is a type of software that enables and facilitates the user to perform specific tasks such as typing application, preparing students mark sheet, playing games etc. The application software can be of general use in any organization or it can also be developed to use in specific organization i.e. the software developed for NADRA, stock exchange, banks etc. Some of the application software are as follows

**Productivity Software:** Productivity software is a type of software that is used to speed up the daily routine tasks performed by individual user or a team at home, colleges or businesses etc. Some of the commonly used productivity software are word processing, spreadsheet, database management and graphic software.

**Business Software:** Business software is used by business users to perform different business tasks. It can be used to increase productivity and to perform business transactions accurately. Some of the business software are accounting system, inventory system and payroll system etc.

**Entertainment Software:** Entertainment software is a type of application software that is developed to entertain the users. Computer games are very popular type of entertainment software. Various entertainment software are also available to play movies and music. Some examples are Windows media player, Real player and Winamp etc.

**Educational Software:** Educational software is used to learn different skills. It provides help and guidance in different subjects such as computer, mathematics and physics etc. Various software are available that teach about human body, working of an engine, solar system, and typing etc.

### 1.2.3- INTERNET APPLICATIONS

Following are the commonly used internet applications.

i- **Web Application:** A web application is a type of program that runs on a remote server. The user communicates with it through web browsers like Internet explorer, Google chrome, and Mozilla Firefox etc. Some of the web applications are Email programs, online ticketing services, online banking services, online auctions, and instant messaging services etc.

ii- **Cloud Computing Application:** Cloud computing application is a type of software that support cloud computing. Cloud computing services are delivered over the internet through web browsers. A cloud computing application entirely stored on a

remote server. The users of a cloud application need a computer with a high speed internet connection.

**iii Social Media Network Applications:** Social media is an internet-based communication system. It allows the people to create and exchange information, ideas, common interests and other forms of expressions. It also allows us to build social relations with other people having similar interests. It connects the people with their friends, families and colleagues over the internet. Some popular examples of social media applications are as follows:

- **Face book:** Face book is one of the most popular social networking services. It is being used by millions of people all over the world. The registered users can create their profiles, upload photos and videos. It helps users to stay updated about the events happening around the world. It is a free service to use.
- **Twitter:** Twitter is a free service that allows registered members to broadcast short posts called tweets. A tweet may consist of up to 280 characters, before it was only 140 characters. The members can also follow the tweets of other users. It is typically used to express the opinion about a particular topic or matter.
- **WhatsApp:** WhatsApp is a free instant messaging service for smart phone users. It is used to exchange text, photos, videos, and audio messages through internet. It also provides an option of group chatting. It was started for android smart phones but now is available for iPhone, Blackberry, Windows and Nokia smart phones.

#### **1.2.4- LICENSED SOFTWARE, OPEN SOURCE SOFTWARE, SHAREWARE AND FREWARE**

##### **Licensed Software**

Licensed software is a type of software that is available for purchase and use under a software license. A Software license is a legal agreement (document) that specifies the terms and conditions for the use and distribution of the software. The software license deals with the Copyright law.

Copyright is a branch of the law which protects creative works from unauthorized use by other people. It allows creators to benefit financially from their work and to keep some control over how they are used. Software that is copied and sold without the permission of the owner is known as pirated software and it is the violation of copyright law. Microsoft Windows and Microsoft Office are some of the examples of licensed software.



### Open Source Software

Open source software is a type of software with source code that anyone can modify and redistribute without any cost. Anyone can modify the instructions of the software and redistribute it. The open source software can usually be downloaded from the internet. Some of the open source softwares are Linux and Open office etc.

### Shareware / Trial-Ware

Software that can be used without being registered or without paying fee for a specified time period (trial period), is known as shareware. After the trial period the user has to purchase the software in order to use it further. Shareware software stops working properly when the trial period is expired. The trial period is usually from 30 to 60 days. Some of shareware softwares are antivirus software and computer games.

### Freeware

Freeware is a type of software that is available free of cost for use for unlimited period of time. Some of the freeware softwares are Skype, Mozilla Firefox, and Google chrome etc.

## 1.2.5- FIRMWARE

Firmware is a type of software that is embedded in electronic devices during manufacturing. It is an intermediate form between hardware and software. Firmware instructions are hardly changed and remain the same. Firmware software is used in ROM, tvs, microwave oven and washing machines etc.

## 1.2.6- INTERNET APPLICATION SECURITY

Internet application security refers to the security of internet applications. It is the measures taken to deal against the threats that may harm the internet applications. These applications run on the servers and can be accessed anytime. They have the risk of attacks from the hackers and other threats over the internet.

To ensure application security, it is essential that we should continuously monitor the activities of server on which application is running and block the threats that are trying to obtain the sensitive data. In order security system consists of firewall, antivirus programs, spyware detection programs, and encryption/decryption programs.

## 1.3- COMPUTER HARDWARE

The touchable parts of computer are known as hardware. All physical components of the system such as keyboard, mouse, monitor, printer, along with the circuitry that connects them are known as hardware. Computer hardware can be categorized into following types on the basis of their nature.

**1- Input Hardware** A type of hardware that is used to enter data into the computer e.g. mouse, scanner, keyboard etc

**2- Output Hardware** A type of hardware that is used to get information from the computer. Output hardware can be divided into two parts as follows

- **Softcopy Output Hardware**

It is a type of hardware whose output is in non-tangible form i.e. its output can only be seen but cannot be touched e.g. monitor

- **Hardcopy Output Hardware**

It is a type of hardware whose output can be seen as well as touched and can be taken from one place to another e.g. printer

**3- Storage Hardware:** Storage hardware is used to store data/instructions either temporarily or permanently. Storage hardware can be classified into two groups as follows

- **Primary (Temporary) Storage hardware Short Term Memory**

This type of hardware is used to store data/instructions temporarily for a short period of time. Such storage devices are volatile i.e. on power failure the stored content will be washed out. RAM is an example of such category.

- **Secondary (Permanent) Storage hardware Long Term Memory**

It is used to store data/instructions for a long period of time. Secondary storage devices are non-volatile i.e. on power failure their contents are unaffected e.g. Hard disk, DC, DVD etc

**4- Processing Hardware:** It is the type of hardware used to process data according to the given instructions to generate output e.g. microprocessor, math co-processor, I/O processor etc.

### 1.3.1- INPUT DEVICES

The devices that are used to enter data and instructions into the computer are known as input devices. Different types of input devices are used to input different types of data. Some of the input devices are as follows

#### Keyboard

It is a device used to enter data into the computer. It is the most commonly used standard input device that consists of a number of keys. The arrangement of keys on the keyboard is called keyboard layout. The most popular keyboard layout is QWERTY. The common keys on the keyboard are as follows

- Alphabetic Keys
- Numeric Keypad
- Function Keys



Keyboard

- Arrow keys / Cursor Movement Keys
- Modifier Keys

### Pointing Devices

A pointing device is an input device that is used to control the movement of the pointer on the screen and to give commands to the computer such as to select item on a screen or to open computer programs. Mouse, trackball, joystick etc. are some of the commonly used pointing devices.

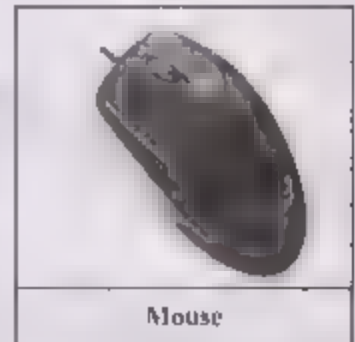
#### Mouse

It is another commonly used input device after keyboard that is more efficient, speedy and flexible than keyboard. It is also called pointing device. There are various types of mouse that are being used i.e. Mechanical Mouse, Optical Mouse, and Laser mouse etc.

**Mechanical mouse** works with the help of small metallic ball, sensors and rollers. The sensors sense the movement of a ball and generates signal accordingly. A pointer is logically attached with a mouse which expresses the position on the screen. A slight movement of the mouse results the change of position of mouse pointer on the screen. Mouse is also known as a pointing device.

An **Optical Mouse** uses a LED (light emitting diode) and photodiodes to detect the movements and translate into the movement of the pointer on the screen. Optical mouse is becoming very popular and replacing the mechanical mouse.

**Laser Mouse** works much like an optical mouse but it uses a laser light, as opposed to an LED light, to measure the movement and transmit the data to the pointer on the screen.



Mouse

#### Trackball

Trackball is similar to mouse. It works like an upside-down mouse. We rest our thumb on the exposed ball and our fingers on the buttons. To move the pointer on the screen the ball is rolled with our thumb because we don't need to move the whole device. A trackball requires less space than mouse. When space is limited a track ball can be an advantage over mouse.



Track Ball

#### Joystick

Joystick is mostly used to play video games. It is a vertical hand-held lever (stick) mounted on the base. The lever (stick) can be moved in different directions to control the movement of the object (pointer) on the



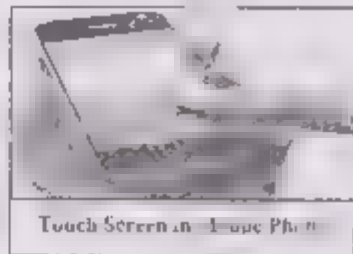
Joystick



screen. It also includes two or more buttons that can be used to perform actions such as fighting, car racing and firing guns and lasers.

### Touch Screen

A touch screen is a touch sensitive display device. It is an input as well as output device. Using this device data is directly entered by touching the screen with user's fingertip. Touch screens are commonly used in devices such as mobile phones, ATMs (Automated Teller Machine) PDAs (Personal Digital Assistant) etc.



Touch Screen in Mobile Phone

### Light Pen

Light pen also known as Pen input device looks like a pen. It is used to point to an object or to draw on the screen. These devices are used by engineers and graphic designers for designing purposes.



Light Pen

### Touchpad

Touchpad is a pressure sensitive pointing input device. It is used in laptop computers. It is a small flat surface over which user slides his fingertip to move the pointer on the screen. It has two buttons located above or below the pad. These buttons work like mouse buttons.



Touchpad on Laptop

### Microphone

Microphones are becoming increasingly important as input devices to give audio data as input to computer. Spoken inputs used in multimedia, phone calls and chat etc. For the input through microphone, a Sound Card is also needed that translates the analog signal (sound waves) into digital codes the computer can store and process. This process is called digitizing. Sound Card also translates digital sound back into analog signal that can be sent to the speakers.



Microphone

### Magnetic Stripe Card Reader

A Magnetic-Stripe card reader is an input device that reads the information encoded in the on the back of plastic magnetic stripe card. The information on the card is read by swiping the card on Magnetic Stripe Card Reader. Credit cards, ATM cards, VISA cards, Master



Magnetic Stripe Card Reader

## OPTICAL INPUT DEVICES

New technologies allow computers to use light as a source of input to the optical input devices. Some of the optical input devices are as follow

### 1- SCANNER

Image scanner is an optical input device that is used to scan images, pictures, printed text or hand written text that can be stored in computer's memory in digital form. Following are the types of scanner

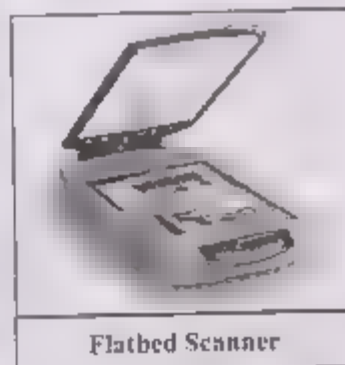
- **Handheld Scanner**

Handheld scanners are very useful for scanning articles from magazine, newspapers and books. To scan image the hand-held scanner is dragged over the image to be scanned. The handheld scanner should be moved carefully because uneven scanning rate would produce distorted image.



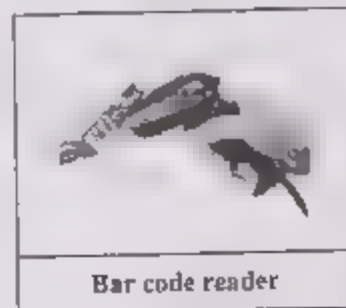
- **Flatbed Scanner**

A Flatbed scanner scans full image of a document or picture at a time. It converts any printed image into electronic form by shining light onto the image and sensing the intensity of light reflection at every point. The image scanner is very useful because it translates printed images into electronic format that can be stored in to a computer's memory for future use. If we want to scan a text document and wants to modify that text after scanning then the **Optical Character Recognition** is used to translate the image into text so that the modification in the text can be possible.



- **Bar Code Reader**

These devices convert a bar code also known as UPC (Universal Product Code), which is a pattern of printed bars on products into a code the computer can understand. These codes represent the price, manufacturing date and other information about the product.



## DIGITAL CAMERA

Digital cameras are similar to traditional cameras except that images are recorded digitally in the camera's memory rather than on film. The images can also be transferred to the computer for further use. Some digital cameras have the capability to record motion digitally and store them into the memory; those can be called **Digital Video Cameras**. Digital cameras have LCD for viewing images. They work as input as well as output device.



## 1.3.2- OUTPUT DEVICES

Output devices are used to display or print text, graphics or pictures. The output generated on paper by an output device such as printer or plotter is called **hardcopy output** whereas the output in the form of data or information stored in a storage device or displayed on a monitor is called **softcopy output**.

### Monitor

Monitor is a softcopy output device whose output can only be seen and cannot be touched. It is also known as a standard output device or VDU (Visual Display Unit), which enables a user to see the information on the screen. There are different types and sizes of monitors that can be distinguished on the basis of following features:

- **Size** – The size of monitor is measured in inches. It is measured diagonally means from upper right corner of screen to lower-left corner. Standard size of monitor is from 15 to 22 inches.
- **Color** – The monitor can be either black and white (monochrome) or color. Nowadays color monitors are being used. The color display screens show output in multiple colors. The color display screens are also called RGB (Red Green Blue) monitors.
- **Resolution:** The number of pixels on the screen shows the resolution of a computer monitor. 640 x 480 means that there are 640 pixels horizontally across the screen and 480 pixels vertically down the screen.
- **Dot Pitch:** The dot pitch is the distance between the pixels on the monitor. It is measured in millimeters. If these dots are not close enough together, then the image on the screen will not be Sharp.

### Types of Monitor

Following are the common types of monitor:

1- CRT Monitor

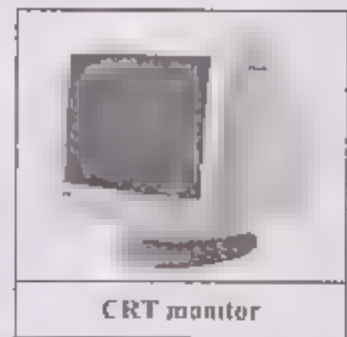
2- LCD Monitor

3- LED Monitor



### 1- CRT (Cathode Ray Tube) Monitors

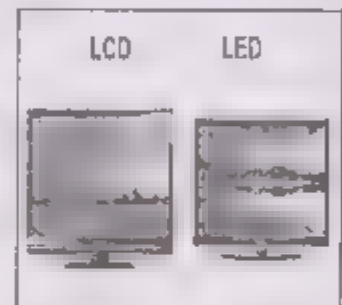
These are typically used monitors in desktop computers that look like a television screen and works in the same way. It consists of electronic gun, electronic beam and a phosphor coated screen. A beam of electron (cathode ray) emitted by the electronic gun passes through focusing and deflection systems that direct the beam to a dark phosphor coated screen at the back of monitor screen and then glow<sup>5</sup> when they are struck by the electronic beam. In color monitor there are three guns for each red, green and blue (RGB colors) and each pixel contains three phosphors. The combination of these gives full color spectrum<sup>5</sup>.



CRT monitor

### 2- LCD (Liquid Crystal Display) Monitors

The LCD monitors create image with a special kind of liquid crystal rather than phosphor. The major advantage of these monitors is that they are light in weight, consume less space, much thinner and provide the brightest display even in bright light. The advantage is that they are expensive. The disadvantage is that the image in LCD monitor becomes blurry<sup>6</sup> as we increase our angle to the screen and image becomes fuzzy<sup>6</sup> quickly.



### 3- LED (Light Emitting Diodes) Monitors

LED monitor is a light-weight flat panel display unit which uses LEDs (light emitting diodes) as pixels for display. As compared to LEDs these monitors produce bright images but it consumes less power but these monitors are expensive than LCDs.

#### Difference between CRT monitor and LCD monitor

CRT Monitor	LCD Monitor
1) It is larger than LCD monitor.	It is lighter weight than CRT monitors.
2) It is commonly used in desktop computers.	It is commonly used with portable computers.
3) It uses Cathode Ray Tube to display output.	It uses Liquid Crystal technology to display output.
4) It takes more desk space.	It takes less desk space.
5) Its viewing angle is unlimited.	Its viewing angle is limited.
6) It is less expensive.	It is expensive.

<sup>5</sup> Same

<sup>6</sup> Vaneity  
not clear

## Printers

Printers are hardcopy output devices whose output can be seen as well as it can be touched. A printer gets the data from the computer (CPU) through a cable connected to a port. The port, which is used to connect printer with the CPU, is called PPI (parallel printer port). Nowadays printer can be connected to USB ports. Printers can be distinguished on the basis of following features.

- The quality of Output
- The ability to print graphics
- The printing speed.

## Types of Printer

There are two types for printers as follows.

1- Impact Printer

2- Non-Impact Printer

### 1- IMPACT PRINTERS

These are the type of printers that creates images by striking the inked ribbon. They press the ink through the ribbon onto a piece of paper. They are simple, easy and have less expensive. Character printers such as dot matrix and line printer are the examples of such category.

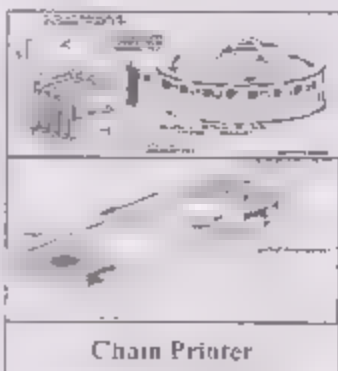
#### • Dot Matrix Printers

Dot Matrix is a character printer that prints one character at a time. Dot matrix printers normally have 9 to 24 pins arranged in the form of a matrix. To print a character on the paper, the built-in microprocessor activates the appropriate pins in the print head to move forward and hit the printer ribbon which is placed against a paper. As a result, the shape of the character appears on the paper. Dot matrix printers form the shape of characters by a number of dots not with the character shape itself therefore the print quality of these printers is low.



#### • Chain Printer

It is a line printer that prints the one complete line at a time. A chain printer mainly consists of a long chain. The chain contains all the printable characters embossed on the chain. The chain can be moved in a circular manner with the help of two pulleys fixed on the extreme ends of the printer. Microprocessor within the printer senses when the correct character appears at the desired print position on the page. At



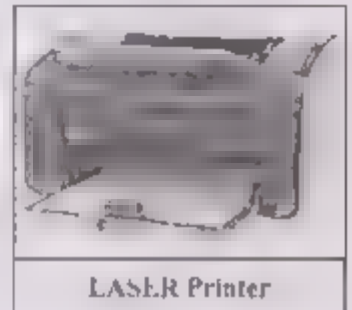
presses the paper against a ribbon and against the character located at that position. As a result, the impression of character appears on the paper. When the requirements of the printed page are fulfilled, the printer moves the page to the next line position.

## 2-NON-IMPACT PRINTERS

Non-impact printers have been developed to produce a printed image without striking the papers. Non-impact printers are noiseless and faster than impact printers. The printing quality and speed of these printers is better than impact printers. Laser and ink jet printers are examples of non-impact printer.

### • LASER(Light Amplification by Stimulated Emission by Radiation) Printer

Laser printer is a page printer, it prints an entire page. It is like a desktop copier in appearance and employs a similar technology. Laser jet printer uses laser light to ink toner cartridges and cylindrical drum to create image on the paper. These printers are very fast and noiseless printers. The print quality of Laser printer is very high and they can also print graphics in different colors.



LASER Printer

### • Ink Jet Printer

Ink jet printer is a type of non-impact printer, it prints characters and graphics by spraying tiny drops of liquid ink on paper. Because the ink is put directly on the paper, therefore, these printers require ink in reservoirs<sup>7</sup> instead of ribbon. Ink jet printers are also available which have more than one ink reservoir, each with different color for printing colored images. Inkjet printers can produce quality text and graphics including photographs.



Inkjet Printer

### Difference between Impact and Non-Impact Printer

	Impact Printers / Dot-Matrix Printer	Non-Impact Printers/Laser Printer
1	They produce noise while printing.	They don't produce noise while printing.
2	They are slower in printing.	They are faster in printing.
3	They have low print quality.	They have high print quality.
4	They are less expensive printers.	They are more expensive.
5	Dot Matrix is a impact printer.	Laser is a non-impact printer.



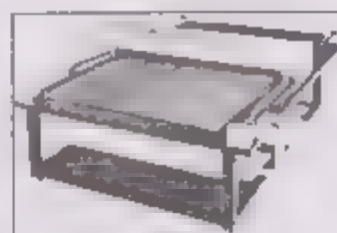
## PLOTTERS

Plotters are special output devices that are used for a variety of applications, which include architectural drawings, graphs, making maps, plotting civil engineering drawings, and producing large size panaflexes etc. Plotters work on the principle of human hand holding a pen and moving it on paper. Plotters are normally very slow output devices but they still plot much faster than a draughtsman and the output is of better quality. Plotters are of two types.

### 1- Flatbed Plotter

#### 1- Flatbed Plotter

Flatbed plotters plot on paper that is lying flat on a table-like surface. Typically, the plot size is equal to the area of a bed. The bed size varies according to the need. Most of the flatbed plotters have one to four pens or pencils of different colors. These pens can be raised or lowered onto the paper and move across the paper to draw charts or graphs.



Flatbed Plotter

#### 2- Drum Plotter

In Drum plotter the paper is placed over a drum that rotates back and forth to produce vertical motion and the drawing pens are mounted on a carriage, which moves across the width of the paper to plot the graph or a different design on the paper. These plotters are used to print large size panaflexes.



Drum Plotter

## SPEAKER

Speaker is a softcopy output device that is used to produce output in the form of sound voice. It is attached to the sound card on the motherboard. Speakers are available in different shapes and sizes.

### Difference between Hardware and Software

	Hardware	Software
1)	Physical parts of the computer are known as hardware.	Non physical parts or set of instructions are known as software.
2)	We can touch, see and feel the hardware.	We cannot touch and feel the software.
3)	If the hardware is damaged it can be replaced with new one.	If software is corrupted it can be reinstalled.
4)	It operates under the control of software.	It controls the operation of hardware.

- 5) <sup>1</sup> Hardware is made of physical materials or components. Software is prepared by writing the instructions in programming language.

### MULTIPLE CHOICE QUESTIONS

Q) Select the best answer of the following MCQs

- \_\_\_\_\_ of the following is the smallest computer.  
A- Mainframe      B- Minicomputer      C- Microcomputer      D- Supercomputer
- How many instructions per second a Microcomputer can execute?  
A- Thousands      B- Millions      C- Billions      D- Above trillion
- What type of software is MS Word is?  
A- System software      B- Application software      C- Utility      D- Language processor
- \_\_\_\_\_ device is most suitable for playing games.  
A- Mouse      B- Keyboard      C- Joystick      D- Light Pen
- Which of the following is an impact printer?  
A- Dot Matrix      B- Laser      C- Ink jet      D- Plotter
- \_\_\_\_\_ software controls the operation of hardware devices.  
A- Utility      B- Language processor      C- Application      D- Device driver
- Which of the following devices is used to print large size hardcopy?  
A- Printer      B- Inkjet printer      C- Laser printer      D- Chain printer
- Which of the following devices converts spoken words to electronic form?  
A- Touch pad      B- Microphone      C- Scanner      D- Camera
- \_\_\_\_\_ software converts computer programs to machine language.  
A- Utility      B- Device driver      C- Language processor      D- Application
- Which of the following is the productivity software?  
A- Spread sheet      B- Utility      C- Windows 7      D- Compiler
- A computer's main function is to  
A- Convert information into storage      B- Convert data into information  
C- Display data      D- Create data from information
- Which device contains embedded computers?  
A- ATM Machine      B- Digital washing machine      C- Microwave oven      D- All
- Any data or instruction entered into computer is called?  
A- Input      B- Information      C- Storage      D- Output
- How many basic operations are performed by a computer?  
A- Five      B- Three      C- Four      D- Two
- Which of the following is not a computer classification?  
A- Mainframe computer      B- Minicomputer      C- Microcomputer      D- Max computer
- Which of the following is not a mobile computing device?  
A- PDA      B- Smartphone      C- Tablet PC      D- Server
- All of the following are system software except  
A- Operating system      B- Utility software      C- Language translator      D- Spreadsheet
- Which of the following is not utility software?  
A- Assembler      B- Defragmenter      C- Disk cleaner      D- File compression
- Which of the following is NOT a social media network application?



20) A. of the following are characteristics of a monitor except

A- Color

B- Speed

C- Resolution

D- Size

**Q No. 1.(b) Write TRUE or FALSE.**

Statement	TRUE / FALSE
i. Computing devices contain embedded computer	
ii. Super computer can process trillions of instruction per second.	
iii. Smart home is a popular application of cloud computing	
iv. Device driver is application software.	
v. Laser printer is a type of non-impact printer	

### EXERCISE QUESTIONS

**Q2, Answer the following questions briefly.**

1- Give important characteristics of computers (Answer is on Page 6).

2- Compare microcomputer with mainframe computer

Ans.

	Microcomputer	Mainframe computer
1)	Microcomputers are small in size	Mainframe computers are large in size
2)	Microcomputers are inexpensive computers	Main frame computers are expensive computers
3)	Micro computers are generally used to communicate with a single user	Main frame computers are used to serve several thousand computers at a time
4)	Microcomputers are less power computers than mainframe computers	Mainframe computers are more powerful computer than microcomputers.

3- Give three application areas each of mainframe and super computer

(Ans is on Page 7)

4- Name few organizations of Pakistan where supercomputers are used.

(Ans on page 7)

5- How barcode system works in a shopping mall?

Ans. In shopping malls barcode system are used to enter the data about the products. The salesperson can enter sales data in computer using barcode reader. The computer uses the input to calculate the bill and to print the receipt for the customer. The transaction of sale is stored in the computer which can be used to analyze the inventory of the stock.

6- Differentiate between computer hardware and software.

(Ans is on Page 23)

**7- Differentiate between system software and application software.**

	System Software	Application software
1)	System software is used to manage the computer resources.	Application software is used to solve particular problems
2)	System software makes the use of computer more effective and efficient	Application software makes the user's problems easy to solve
3)	Example of system softwares are Operating system, Device drivers, Utility software etc	Examples of application softwares are Productivity software, business software, entertainment software etc

**8- Define licensed software. (Answer is on Page 13)**

**9- Differentiate between shareware and freeware.**

**Ans.** The difference between shareware and freeware is that freeware is available free of cost for unlimited period of time whereas shareware is available free of cost but for limited period of time

**10- Briefly describe magnetic stripe card.**

**Ans.** A magnetic-stripe card has a stripe which is used to store encoded information on it. The information on the card is read by swiping the card on Magnetic Stripe Card Reader. Magnetic stripe is used on ATM cards, Visa cards and Master cards etc.

**11- Give any five advantages of using LCD monitor over CRT monitor.**

**Ans.** i) LCD monitor is light in weight  
 ii) It is small in size  
 iii) It consumes less power  
 iv) It provides better display.  
 v) It does not emit harmful radiation.

**12- Why LED monitors are better choice of LCDs? Give three reasons to support your answer.**

**Ans.** i) LED monitors consume less power than LCD monitor  
 ii) It is thinner than LCD  
 iii) It produces brighter image than LCD.

**13- Why dot matrix printers are becoming obsolete?**

**Ans.** The dot matrix printers are becoming obsolete because they produce a lot of noise while printing. The printing speed of dot matrix is also very slow. They do not provide high quality output.

**14- What are the advantages of using laser printer over dot matrix printer?**

- Ans.** i) Laser printer gives high quality printing output than dot matrix printer  
ii) Its' printing speed is very fast than dot matrix printer  
iii, L. produces very less noise than dot matrix printer

**15- Give any three uses of plotters.**

- Ans.** i) Plotters are used to produce large size hardcopy output  
ii) Plotters are used to print engineering drawings.  
iii) They are used to produce large size panafaxes  
iv) They are used to plot graphs.

**Q3. Answer the following questions**

- |  |                               |
|--|-------------------------------|
| 1. Describe the types of system software.            | <i>(Answer is on Page 10)</i> |
| 2. Why scanners are used? Describe their types.      | <i>(Answer is on Page 18)</i> |
| 3. What are output devices? Explain its types.       | <i>(Answer is on Page 19)</i> |
| 4. Why plotters are used? Briefly explain its types. | <i>(Answer is on Page 23)</i> |
| 5. What is non-impact printer? Describe its types.   | <i>(Answer is on Page 22)</i> |



## UNIT 2

### COMPUTER MEMORY

#### 2.1- COMPUTER MEMORY

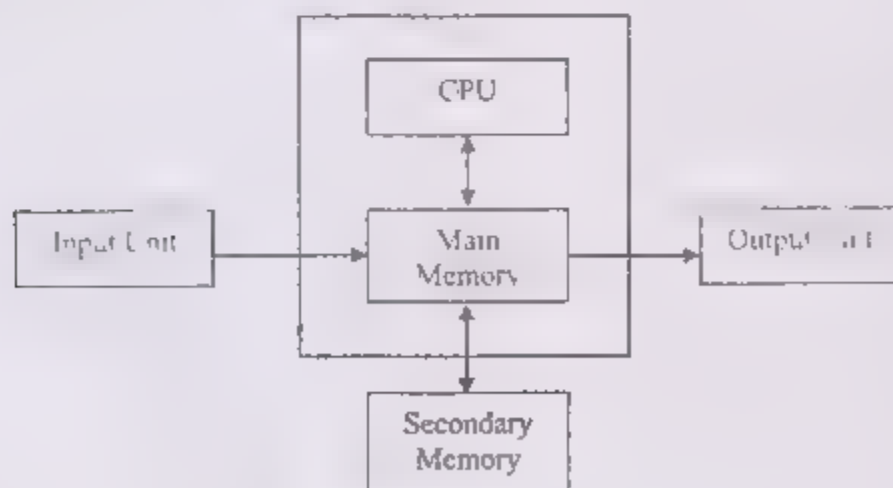
Memory is a physical storage device that is used to store data. Instructions are either temporarily or permanently. Memory contains the main part of operating system and all the application programs and related data that is being used. There are two common types of memory as follows:

- **Main Memory/ Primary Memory**

Main memory is a type of memory that directly communicates with CPU. It is also called primary memory. This type of memory is used to store data instructions temporarily for a short period of time. All programs are first loaded into main memory and then executed by processor. Such storage devices are volatile i.e. on power failure the stored contents are washed out. RAM is an example of such category.

- **Secondary Memory**

Secondary memory is a type of memory that stores the data permanently. The data and programs are transferred from secondary memory to main memory for execution. It provides huge capacity for data storage. Secondary memories are non-volatile i.e. on power failure their contents are not affected. It is also known as backup storage, auxiliary storage or mass storage. Hard disk is an example of secondary memory.



Block Diagram of a computer.

### 2.1.1- CHARACTERISTICS OF MEMORY

- **Access Mode:**

The way a memory can be accessed is known as access mode. Memory has two major types of access modes i.e. **Sequential Access Mode** and **Random Access Mode**

In **Sequential access mode** the data in the memory can be accessed in a sequential manner. For example if the 5<sup>th</sup> location of a memory is to be accessed then it is only accessed after accessing first four locations. Sequential access mode is a so called serial access mode.

In **Random access mode** i.e. data in any location of memory can be accessed without any sequence or the data can be accessed directly. For example if the 5<sup>th</sup> location of a memory is to be accessed then it is accessed directly without accessing other locations in sequence. Random access mode is also called direct access mode.

- **Access Time**

Access time is the amount of time required to locate and retrieve stored data from the memory. The speed of memory accesses can be measured by access time. Normally Sequential Access Memories like magnetic tapes have the longer access time than Random Access Memories like RAM.

- **Data Transfer Rate**

It is the amount of time required to transfer data from one memory to other. For example time taken to transfer data from hard disk to main memory (RAM).

- **Storage Capacity**

It is the amount of space available to store data in the memory or to execute programs.

- **Cost**

The price of memory is known as cost. It typically depends on the capacity and access time of the memory. Primary memory units have shorter (faster) access time, smaller storage capacity and higher cost, whereas secondary memory units have longer (slower) access time, higher storage capacity and lower cost.

### 2.1.2- MEMORY TERMINOLOGIES / MEMORY CAPACITY UNITS

- **Bit:** A smallest unit of memory is bit. It stands for binary digit. A bit can be 0 or 1. The computer memory is made up of small storage areas called Cells. One bit (either 0 or 1) is stored in a cell.
- **Byte:** Byte is a basic unit of memory. It is a collection of eight bits. At least one byte is required to store a single character. The capacity of memory is expressed in terms of bytes. The higher units of bytes are as follows:

1 Kilo Byte	=	$2^{10}$	=	1024 bytes
1 Mega Byte	=	$2^{20}$	=	1024 KB
1 Giga Byte	=	$2^{30}$	=	1024 MB
1 Tera Byte	=	$2^{40}$	=	1024 GB
1 Peta Byte	=	$2^{50}$	=	1024 TB
1 Exa Byte	=	$2^{60}$	=	1024 PB

### • Memory WORD

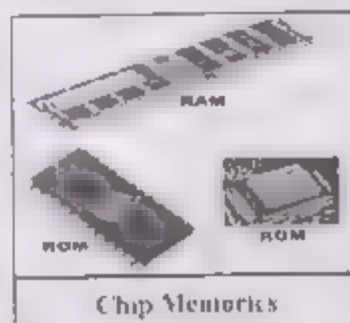
A group of bits (cells) is known as a **Memory WORD**. The WORD size refers to the number of bits a computer can process at a time. A bigger word size means that the CPU can process more bits at a time. It improves the processing speed of computer. The main indication of the word size is how much memory the processor can address. A 32-bit processor is limited to  $2^{32}$  addresses. This is a group of bits (cells) in memory that represents data of some type.

## 2.1.3.1- TYPES OF MEMORY BASED ON MANUFACTURING

Following are the types of memories based on the manufacturing.

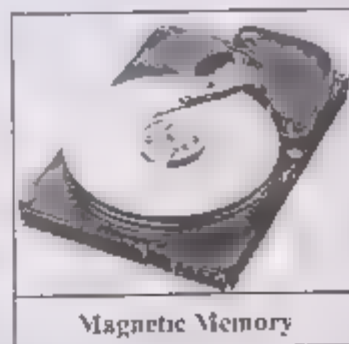
### 1- Chip Memory / Electronic Memory

A chip memory is a type of memory that consists of electronic chips. It contains integrated circuit embedded on it. It may also contain millions of electronic components like transistors and resistors. The chip memory is fast as compare to other memories because it does not have any mechanical moving parts. Examples of chips memories are Main memory like RAM, ROM and Cache etc. Flash memory drives, and memory cards etc.



### 2- Magnetic Memory

The magnetic memory is a type of memory that store huge amount data and instructions using magnetic material. It is one of the most widely used types of storage medium. The magnetic tape and magnetic disks are examples of magnetic storage. A thin layer of magnetic material is coated on the surface of the magnetic disks and tape. The data is stored in the form of magnetized and non-magnetized spots on the surface. A magnetized spot represents a binary 1 and a non-magnetized spot represents a binary 0. Magnetic memories are slower because of slower access time and transfer rate. On the other hand these types of memory are



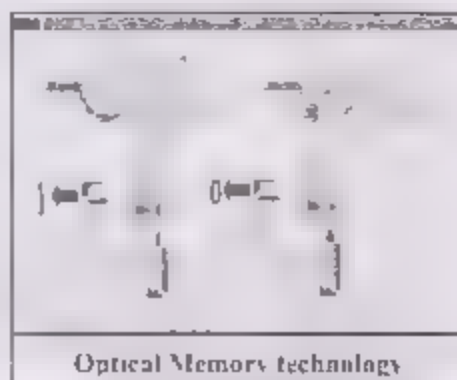
Magnetic Memory



inexpensive than chip memory and the storage capacity of these memories are also very large than chip memories.

### 3- Optical Memory

The optical memory is a type of memory that store huge amount data and instructions using laser beam (light). It usually stores software, audios and videos. The laser light writes data on the surface of an optical disc in the form of tiny pits and lands. A pit represents a binary 0 and a land represents a binary 1. Optical discs generally store data in a single track that spirals from the center of the disc to the edge of the disc. Optical memory is inexpensive than magnetic memory. CD, DVD and blue ray discs are examples of optical memory.



#### 2.1.3.2- TYPES OF MEMORY BASED ON RETENTION POWER

Following are the types of memories based on retention power

##### 1- Volatile Memory

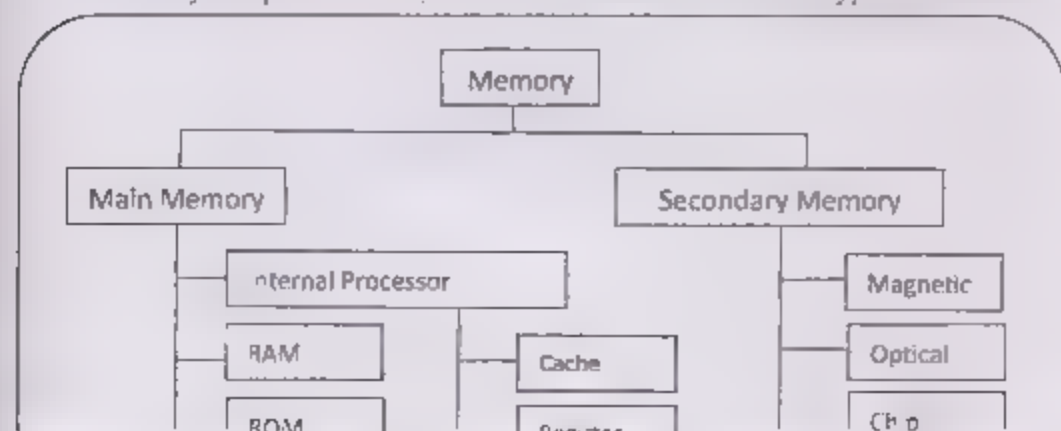
A volatile memory is a type of memory that requires electric power to retain its contents. The data stored in volatile memory is lost if the power is turned off. It is also known as temporary or short term memory. RAM, cache memory and registers are examples of volatile memory.

##### 2- Non-Volatile Memory

A non-volatile memory is a type of memory that does not requires electric power to retain its contents. The data stored in non-volatile memory is not lost if the power is turned off. It is used to store the data/instruction permanently for future use. It is also known as permanent or long term memory. ROM, magnetic storage devices, optical storage devices are example of non-volatile memory.

#### 2.1.4 TYPES (CLASSIFICATION) OF COMPUTER MEMORY

Generally computer memory can be classified into two main types as follows



## 2.2- MAIN MEMORY

Main memory also called primary or internal memory is a part of the computer system that holds data and instructions for processing. Normally it is used to store data/instructions that are used to boot up the computer or to run various types of programs such as operating system and other programs. When user runs software from a storage medium, it is first loaded in the main memory (RAM) and then executed or processed.

### Types of Main Memory

Generally main memory is divided into the following types

1- Internal Processor Memory

2- RAM

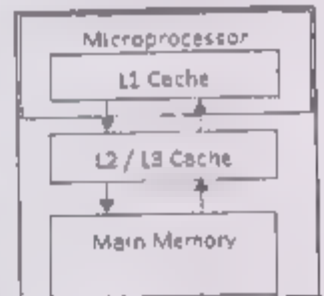
3- ROM

#### 2.2.1- Internal Processor Memory

The types of memories that are directly accessible to the CPU are known as internal processor memory. These memories are very fast memories. Cache memory and processor registers are example of internal processor memory.

##### • Cache Memory

Cache memory is a small and very fast memory. It is designed to speed up the transfer of data and instructions to CPU. Since the processing speed of a processor is greater than the access time of RAM so, the processing capabilities of processor are wasted in just waiting for the data. In order to overcome this problem a very fast memory called cache memory is introduced between RAM and the processor. Now when any information is required by the processor, first it is looked up in the cache memory, and if it is not available in the cache then the processor gets it from the main memory i.e. RAM. Nowadays several types of Cache memory available as



- L1 (Level 1) Cache inside the CPU.
- L2 (Level 2) Cache on the motherboard.
- L3 (Level 3) Cache on the motherboard.

##### • Registers

Registers are extremely fast temporary storage devices inside the CPU used to store data, instructions and memory addresses during the execution of the program. Accumulator register, Program Counter, Memory Address register are some of the types of registers.

#### 2.2.2- RAM (Random Access Memory)

The word Random implies that any location can be randomly (directly) selected and used to store and retrieve data or instruction. It is a semi-conductor memory.

and also referred to as a **READ/WRITE memory**. RAM is used in a computer for storage of active programs and data. Large RAM size provides larger amount of information to a computer for processing and therefore increased the processing speed. The major disadvantage of RAM is that it is **volatile** in nature and therefore loses all stored information if the power is turned off. There are two types of RAM



RAM

#### • Dynamic RAM (D-RAM)

DRAM stands for Dynamic Random Access Memory. DRAM must be recharged many times each second because it loses its contents if it is not refreshed or recharged. It requires electric current to maintain its electrical states. The electric charge of DRAM decreases with the time that may result in loss of data. It is relatively inexpensive and slow type of RAM.

#### • Static RAM (S-RAM)

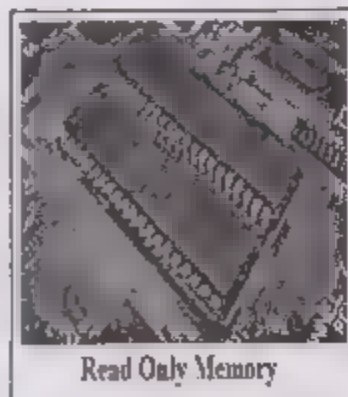
SRAM stands for Static Random Access Memory. It is considerably faster than DRAM because it doesn't need to be recharged to hold its contents. It utilizes less power. S-RAM is expensive and faster than D-RAM. SRAM technology is used to build a very fast memory that is known as cache memory.

#### Difference between D-RAM and S-RAM

	D-RAM	S-RAM
1)	It is slower than SRAM	It is faster than DRAM
2)	It is a cheaper memory than SRAM	It is more expensive.
3)	It needs to be recharged frequently	It doesn't need to be recharged frequently
4)	It consumes more power	It consumes less power

#### 2.2.3- ROM

ROM stands for Read Only Memory. This type of semiconductor memory is a **non-volatile** memory that is designed to hold information that is either permanent or will not change frequently. During normal operations, no new data can be written into a ROM, but data can be read from the ROM. The programs or instructions written on the ROM are called **firmware**, which is usually done in the factory during manufacturing. The instructions in ROM are used for booting the computer and performing the **POST** (Power OnSelf Test) action.



Read Only Memory



### Types of ROM

- **PROM (Programmable Read Only Memory)**

PROM stands for Programmable Read Only Memory. A PROM is a semiconductor chip that is obtained from the manufacturer in an un-programmed state and the user programs it according to his desire. A commercially available machine called **prom programmers** are used to program it. However, once the chip has been programmed, the recorded information cannot be changed. PROM is also a non-volatile memory.

- **EPROM (Erasable Programmable Read Only Memory)**

EPROM stands for Erasable Programmable Read Only Memory. The information stored in a ROM chip or PROM chip cannot be erased or modified. EPROM overcomes this problem and makes it possible to erase information stored in it and the chip can be reprogrammed to store new information. Exposing the chip for sometimes to ultraviolet light erases information stored in an EPROM chip.

- **EEPROM (Electrically Erasable Programmable Read Only Memory)**

EEPROM stands for Electrically Erasable Programmable Read Only Memory. As the name implies, the contents of EEPROM can electrically be erased and reprogrammed. It works like a flash memory. It is a READ/WRITE semiconductor memory while having the nonvolatile nature.

### Difference between RAM and ROM

Sno	RAM	ROM
1)	It is a Read/Write Memory.	It is a Read Only Memory.
2)	It is a temporary memory.	It is a permanent memory.
3)	The user can read and write data and instructions into it at any time while the computer is running.	Only the manufacturer of the ROM can write instructions into it at manufacturing time.
4)	It has a large storage capacity.	It has a small storage capacity.
5)	It is a volatile memory.	It is a non-volatile memory.

## 2.3- SECONDARY MEMORY

The main purpose of secondary memory is to store huge amount of data and programs on permanent bases. These memories are also known as backing storage, auxiliary storage or mass storage. These memories are nonvolatile in nature and retain the data even if the power is turned off.

### 2.3.2- Difference between Sequential Access Memory and Direct Access Memory

Sequential Access Memory	Random Direct Access Memory
1) It reads/writes data in sequence.	It reads/writes data randomly directly into any location of memory.

2,	Its access time is longer	Its access time is shorter
3)	Due to longer access time its storage access mechanism is slow	Due to shorter access time its storage access mechanism is fast
4,	Magnetic tape is an example of Sequential Access Memory	Semiconductor memories like magnetic disk and RAM are examples of Random Access Memory
5)	It is cheap in price.	It is expensive in price

### 2.3.3- TYPES OF SECONDARY STORAGE DEVICES

Following are the types of secondary storage devices

#### 1- Magnetic Tape

Magnetic tape is the old medium of secondary storage. It resembles with the tape used in tape recorders. In the beginning magnetic tapes were mostly used as secondary device but now a day it is being used as a backup storage device. It is an inexpensive storage medium but the main disadvantage of magnetic tape is the sequential access method which makes it a slow storage device. Modern tapes can store data up to 5 TB.



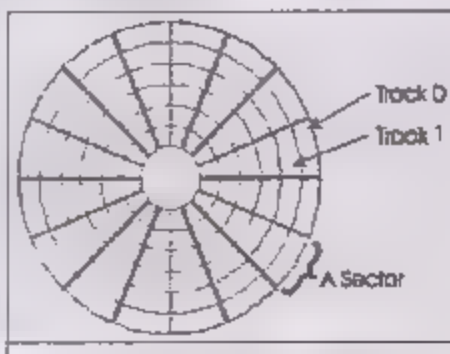
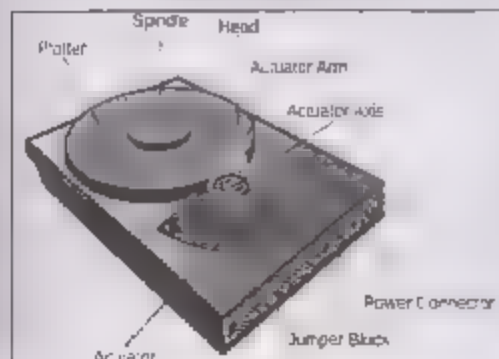
Magnetic Tape

#### 2- Magnetic Disk

The most popular type of secondary storage device is the magnetic disks. They store data even when the electricity is not supplied to them. The data is stored on the disk in binary form as tiny magnetized and non-magnetized spots. Hard disk is the common type of magnetic disk in use today. The other types of magnetic disks were also used in the past such as floppy disk and zip disk. These disks are obsolete and not in use today.

##### Hard Disk

Hard disk also known as fixed magnetic disk is used to store large amount of data permanently for a long period of time. It is the most widely used secondary storage device. The storage capacity of hard disks is in Tera-Bytes.



Hard disk consists of one or more disks called platters that are coated with magnetic material on both sides. The platters are attached to a spindle that holds them in parallel with equal gaps. Each platter has two read/write heads, one for each side. The hard disk also has arms that move the read/write heads to the proper location on the platter to read and write data. The data is stored on the surface of the disk in concentric circles called tracks. Each track is further divided into small parts called sectors.

### Portable Hard Drive

Portable hard drive is used as a portable secondary or backup storage device. It is a light weight and compact magnetic disk drive. It consists of one or more platters that are air-sealed inside casing. It is attached to computer through a USB port. The common storage capacity of a portable hard drive is from 500 GB to 4 TB. It can be used to store programs, photos, audio, video and documents etc.



The new models of portable hard drive use USB 3.0 technology that provides faster data transfer rate. Some portable hard drives also have built-in wireless capabilities to communicate with computer via Wi-Fi connection.

## 3- OPTICAL DISC

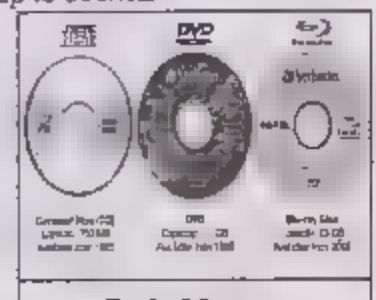
Optical discs are becoming very popular secondary storage devices after magnetic storage devices. These devices fall into a category of optical storage because they store data with the help of Laser light. It stores data in the form of bumps (pits) and lands where pit represents a binary 0 and land represents a binary 1. Following are the most commonly used optical storage devices.

- **CD (Compact Disc)**

CDROM stands for Compact Disc Read Only Memory. It is a popular medium for storing audio data. However, it can also be used to store large capacity software, but the information in the CD is fixed and cannot be changed. New technologies enable us to store and erase data from CDROM, which requires Recordable or Re-Writable CDROM. It is 1.2 millimeter thick with a diameter of 120 millimeter. The storage capacity of CD is up to 800MB.

- **DVD (Digital Versatile Disc)**

DVD stands for Digital Versatile Disc, which looks like CD but it is gaining popularity because of its storage capacity. It can store seven to fourteen times more data as compared to CDROM that makes it capable to store the video.





replacing the other storage media due to its storage capacity and other features. The storage capacity of DVD is from 7 GB to 16 GB.

#### ▪ Blue Ray Disc

Blue Ray Disc is a new type of optical disc. It is faster than CDs and DVDs. It is very durable because it has a special coating to protect it from scratches. It provides higher capacity and better quality than CDs and DVDs. The storage capacity of Blue Ray Disc is up to 300 GB.

#### Difference between DVD (Digital Versatile Disc) and Blue Ray Disc

	Digital Versatile Disc	Blue Ray Disc
1)	Provides less storage than Blue Ray Disc i.e. 2GB to 16 GB	Provides more storage than Digital Versatile Disc i.e. up to 300 GB
2)	Inexpensive than Blue Ray Disc	Expensive than Digital Versatile Disc
3)	Slower than Blue ray disc	Faster than Digital Versatile Disc
4)	It is less durable than blue ray disc	It is more durable than DVD
5)	Uses Red laser light	Uses Blue laser light

#### 4- FLASH MEMORY / CHIP MEMORY

A flash memory is a type of EEPROM. It is a solid state storage which means that there are no moving parts in it. The data stored on flash memory can be erased and new data can be written. It got its name as 'Flash' because it can store and erase data very quickly.

##### Type of Flash Memory /Chip Memory

Two types of flash memory are as follows:

##### i- Flash Drive

Flash drive is a small portable drive that is connected to the computer through USB port. It is also called USB flash drive. It is commonly used to transfer data from one computer to other. Flash drive is available in different shapes and sizes. The storage capacity of Flash drive is up to 256 GB or more.



Flash Drive

##### ii- Flash Memory Cards

Flash memory cards are commonly used in electronic devices such as digital cameras, mobile phones and video games etc. They come in various sizes with different storage capacity.



Flash Memory Cards

### Advantages of Flash/Chip Memory

- i- It is a non-volatile memory
- ii- The data can be erased and stored very quickly
- iii- It consumes very less power
- iv- It is light in weight and small in size
- v- It has no moving parts that's why does not make any noise

### MULTIPLE CHOICE QUESTIONS

Q.No. 1 (ii) Select the best answer of the following MCQs

- 1) Which of the following is the fastest memory?
  - A- RAM                      B- ROM                      C- Cache Memory                      D- USB flash drive
- 2) How much is 1 MB memory equal to
  - A- 1024 bytes                      B- 1024 TB                      C- 1024 KB                      D- 1024 GB
- 3) Which of the following is volatile memory?
  - A- RAM                      B- ROM                      C- PROM                      D-EEPROM
- 4) Which of the following has highest storage capacity?
  - A- DVD                      B- Blue-Ray                      C- CD                      D- Floppy
- 5) USB flash drive is what type of memory?
  - A- Magnetic                      B- Optical                      C- Electronic                      D- Primary
- 6) Which of the following memory devices has the highest storage capacity?
  - A- RAM                      B- Cache                      C- CD                      D- Memory Card
- 7) Which of the following storage devices is non-volatile?
  - A- Hard Disk                      B- CD                      C- Memory card                      D- Floppy Disk
- 8) Which memory communicates directly with the CPU?
  - A- Main memory                      B- Secondary Memory                      C- Hard disk                      D- USB flash
- 9) Which of the following devices has sequential access to data?
  - A- Magnetic Disk                      B- Optical Memory                      C- Magnetic Tape                      D- Chip memory
- 10) Where are registers located?
  - A- Inside hard disk                      B- Inside DVD                      C- Inside RAM                      D- Inside CPU
- 11) \_\_\_\_\_ is the time taken to retrieve data from memory
  - A- Access time                      B- read time                      C- Write time                      D- Memory time
- 12) Which of the following is generally used to express the memory size of computer
  - A- Byte                      B- Resolution                      C- DPI                      D-Pixel
- 13) The number of bits the processor can transmit at a time is called?
  - A- Bus Width                      B- Word Size                      C- Access time                      D-Speed
- 14) Which of the following is not an example of chip memory
  - A- RAM                      B- Memory card                      C- Flash memory                      D-Magnetic disk
- 15) Memory consist of?
  - A- Set of wires                      B- Set of base                      C- Cells                      D- Ports
- 16) Cache memory is
  - A- Faster than RAM                      B- Slower than RAM
  - C- Smaller than RAM                      D- both A and C

- 17) A \_\_\_\_\_ is an example of solid state memory device  
 A- USB flash      B- Floppy disk      C- Hard Disk      D-CD
18. The storage media such as a CD reads and writes data using  
 A- Laser beam      B- Magnetic dots      C- Magnetic strips      D-Electrical Charges
19. The track on a disk is further divided into small parts called  
 A- Cluster      B- Sector      C- Field      D-Block
- 20) Identify the correct one  
 A- 100 MB is larger than 50 GB      B- 1 TB is smaller than 4 GB  
 C- 47 KB is larger than 16 MB      D- 250 bytes is smaller than 0.5 MB

**Q.No. 1.(b) Write TRUE or FALSE.**

Statement	TRUE or FALSE
i. Secondary memory directly communicates with CPU	
Chip memories do not have any mechanical moving parts	
ii. RAM is a non-volatile memory	
iv. In optical discs pit is used to represent 0.	
v. Blue ray disc is an example of magnetic storage	

**EXERCISE QUESTIONS**

**Q2. Write short answers of the following questions.**

- 1- State three differences between primary and secondary memory

	Primary memory	Secondary memory
1.	Primary memory is small in size and expensive in cost.	Secondary memory is large in size and cheap in cost.
2)	It provides faster data access.	It provides slower data access.
3)	It directly communicates with CPU	It doesn't directly communicate with CPU

2. Differentiate between sequential access and direct access memory

Ans. (Answer is on Page 34)

- 3- Why data access time in sequential access devices is more than the random access devices?

Ans. The data access time in sequential access devices is more because they use sequential access mode i.e they access the data one by one from the beginning in sequence. They continue accessing data until required data is found.

4. If cache is removed from a computer, what will happen to it?

Ans. If cache memory is removed from a computer the computer will perform slower because the CPU will access the data from RAM instead of cache memory and the access time of RAM is slower than cache memory.

5. Define memory word

(Answer is on Page 30)

6. Differentiate between RAM and ROM (Answer is on Page 34)

- 8- Give few advantages of using flash memory. *(Answer is on page 38)*
- 9- How the size of RAM affects the processing speed of a computer system?

Ans The role of RAM is very important in the processing speed of a computer. A large RAM size provides larger amount of space therefore can load more files in and CPU can access more data from RAM. So the processing speed is increased.

**Q3. Write long answers of the following questions**

- 1- What is internal processor memory? Explain different types of internal processor memories used in computer. *(Answer is on Page 32)*
- 2- Explain magnetic tape and hard disk. *(Answer is on Page 35)*
- 3- What is optical disk? Describe its types. *(Answer is on Page 36)*
- 4- What is flash or Chip Memory? Explain its types. *(Answer is on Page 37)*



## UNIT 3

### CENTRAL PROCESSING UNIT

#### 3.1- INSIDE CPU (Central Processing Unit) / Microprocessor

The CPU is also called microprocessor. It is the brain of a computer system. As in a human body, the brain takes all major decisions and other parts of body function is directed by the brain. Similarly, in a computer system, all major calculations and comparisons are made inside the CPU and it is also responsible for activation and controlling the operations of other units of a computer system.



CPU

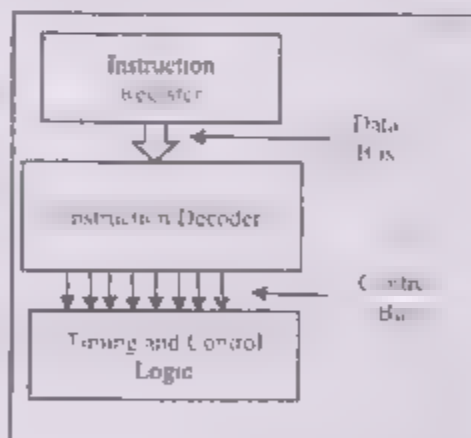
#### 3.1.1- COMPONENTS OF CPL

Following are the components of a CPU

- CU
- ALU
- Cache Memory (L1 Cache)
- Registers
- Internal Buses

#### CU (Control Unit)

Control Unit is the part of CPU which works like a traffic cop in a computer system. It directs and coordinates all the operations of the entire computer system. It controls ALU, all the memory devices, and all the input/output devices. CU controls the operation of computer system based on the instructions in the program by executing them in proper order. CU consists of the following components:



Control Unit

- |                                |   |
|--------------------------------|---|
| i. Instruction Register        | It stores the instruction being executed  |
| ii. Instruction Decoder:       | It decodes (translates) the instruction so that the computer can understand it. |
| iii. Timing and Control logic: | It generates the signals to execute the instruction.                            |

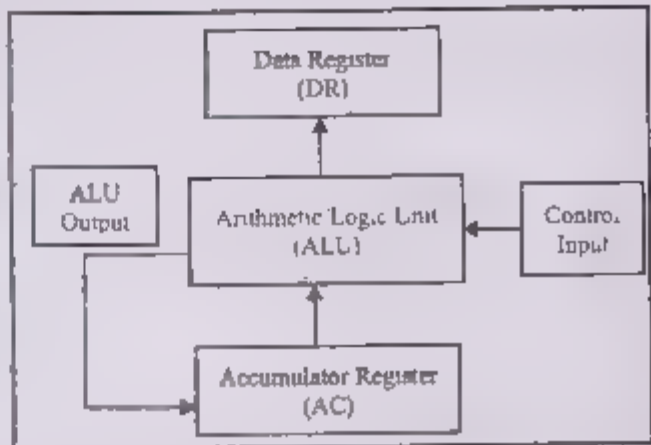
#### ALU

Arithmetic Logic Unit is the part of CPU where actual processing takes place. The function of ALU is to perform arithmetic operations such as addition, subtraction,

### Working of ALU to add two numbers

ALU performs the following steps to add two numbers 20 and 4

1. The first number 20 will be stored in accumulator register (AC)
2. The second number 4 will be stored in data register (DR)
3. The control unit will send the signal to ALU to add the numbers.
4. The ALU will add the numbers.
5. The result 24 will be stored to accumulator register (AC)
6. Lastly the result will be transferred from accumulator register to main memory (RAM) if required.



### Cache memory (L1 Cache Memory)

Cache memory (L1 Cache Memory) is a small and very fast memory inside the CPU. It is designed to speed up the transfer of data and instructions to CPU. Cache memory stores the data and instructions that are frequently required by the CPU.

### Registers

Registers are extremely fast temporary storage devices inside the CPU used to store data, instructions and memory addresses during the execution of the program. Accumulator register, Program Counter, Memory Address register are some of the types of registers.

### Internal Buses

A Bus is a path between the components of a computer. It is a group of parallel wires through which a group of bits are transmitted from one part of the computer system to another part. The number of bits that can travel simultaneously down a bus is known as **bus width**. The buses found inside the CPU are known as internal buses. There are three types of buses: namely Data bus, Address bus, and Control bus.

### 3.1.2 REGISTERS

Registers are the extremely fast temporary storage devices inside the CPU used to store data, instructions and memory addresses before, during and after some operation as directed by the CU. The registers used in a computer are divided into two types as follows.

1- General Purpose Register

2- Special Purpose Registers

## 1- General Purpose Registers

The general purpose registers are used in mathematical and logical calculations. These registers are the part of ALU. They can store data as well as memory addresses. The size of these registers is from 8 to 32 bits. Some of the commonly used general purpose registers are as follows:

### i- Accumulator (AC) and Data Register (DR)

These two registers hold the operands that are loaded from memory. The ALU operates on these registers during the execution of instruction and performs some operations such as addition, subtraction, multiplication etc. Both registers can be used to store the operands but the result of arithmetic operation will always be stored in the Accumulator register and only accumulator register can transfer the data back to memory.

### ii- Base Register (BR)

Base register is used to hold a number that can be added or subtracted from the address portion of a computer instruction to form an effective address. It is also known as index register.

### iii- Counter Register (CR)

It contains the address (location) of the instruction being executed. When each instruction is fetched the counter register increases its value by 1.

## 2- Special Purpose Registers

The special purpose registers are used to store the state of the program. The Control Unit uses these registers to control the operation of the CPU. Operating system also uses these registers to control the execution of the program. Some of the commonly used special purpose registers are as follows:

### i- Program Counter (PC)

Program Counter stores the address of next instruction to be executed. It works as a counter that controls the sequence in which the instructions are fetched from memory. The PC is incremented when the content (address) is transferred to MAR.

### ii- Memory Address Register (MAR)

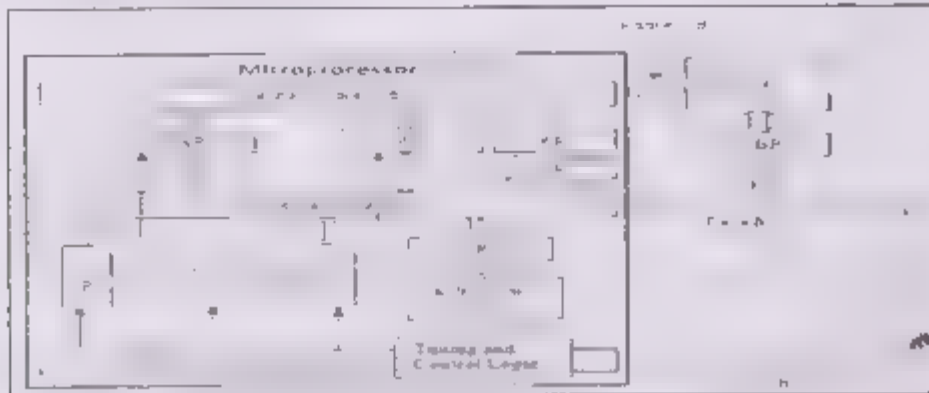
Memory Address Register holds the address of memory from where CPU fetches the memory word (data) or where data is to be stored.

### iii- Memory Buffer Register (MBR)

Memory Buffer Register holds the contents of data (memory word) fetched from or stored into memory. When CPU reads instruction from the memory address provided by MAR, it transfers the contents to MBR. Similarly when CPU writes (store) data into memory the contents of MBR are stored to the memory.

#### iv-Instruction Register(IR)

Instruction Register holds the instructions that are fetched from memory for execution. The instruction decoder of Control Unit decodes the instruction stored in IR and the timing and control logic of Control Unit generates the signals to execute the instructions.



Microprocessor bus architecture associated with registers

### 3.1.3- BUSES

A bus is a path between the components of a computer. It is a group of parallel wires by which data is transferred from one part to another. There are three types of bus systems: 1) Data bus, 2) Address Bus, 3) Control bus.

- 1- **Data Bus** Data bus is a bidirectional bus that is used to transfer the data from main processor to memory for READ operation or from memory to the main processor for WRITE operation. It is called as data bus but it can carry data as well as instructions fetched by microprocessor. Data bus width is from 32 bits to 64 bits.
- 2- **Address Bus** Address bus is used to connect the CPU with main memory to access particular address in main memory. It is a unidirectional bus that carries address from microprocessor to the memory to select the memory WORD for a READ or WRITE operation. Address bus width is from 16 bits to 32 bits. A computer with a 32-bit address can address  $2^{32}$  (4,294,967,296) memory locations.
- 3- **Control Bus** Control bus is a unidirectional bus used to carry a set of timing and control signals to all the parts of computer required to carry out the instructions. These signals are used to direct the activities of all parts. For example, the control bus is used by the Control Unit to direct and transfer data from memory to ALL. Control bus width is from 8 bits to 16 bits.

### 3.2- CPU OPERATIONS

The main component of computer system is the CPU. It carries out the instructions by



The basic operation of most CPUs is to execute a sequence of stored instructions called a program

### 3.2.1- INSTRUCTION CODE

Microprocessor fetches instructions stored in memory (RAM) to execute. An instruction (instruction code) is a group of bits that tells the computer to perform specific operations. Each of the instruction has two fields as

- **Operation Code.** Operation code specifies the type of action to be performed for example ADD, SL B, MOV, INC, LDA, and STORE etc
- **Operand:** Operands are Actual data or it may be a memory addresses (where actual data is placed) on which the operation is to be performed

### TYPES OF INSTRUCTIONS

The modern computer support different types of instructions as follows.

- 1- Data Transfer Instructions
- 2- Data processing instructions
- 3- Program control instructions

#### 1- Data Transfer Instructions

The data transfer instructions are used to transfer the data from one location to another location in the computer. These instructions do not change the actual data. The most common data transfers are between register to register, between registers and memory, and between registers and memory.

Some commonly used data transfer instructions are

- **MOV (Move):** This instruction is used to transfer data from memory to register, register to memory, and register to register. For example the instruction **MOV A, B** will move the value of register B to the register A.
- **LD (Load):** This instruction is used to load a register with the contents from the memory. For example the instruction **LD A, 40** will load 40 in register A.
- **STO (STORE):** This instruction is used to store information from a register to memory.

#### 2- Data Processing Instructions

The data processing instructions are used to perform arithmetic and logical operations on the values stored in the registers. The result of the operation is also stored in the specified register. Some commonly used data processing instructions are

- **Arithmetic instructions:** These instructions are used to perform arithmetic operations such as **ADD** is used for addition, **SUB** is used for subtraction, **MUL** is used for multiplication and **DIV** is used to division etc.
- **Logical instructions:** These instructions are used to perform logical operations such as **AND, OR, NOT**.

- **Shift instructions** These instructions are used to transfer bits for an operand from left to right and from right to left.

### 3- Program Control Instructions

The program control instructions are used to control the execution of different instructions in a program. They can be used to change the order in which instructions are executed. Some commonly used program control instructions are

- **JMP (JUMP)** this instruction is to move the control of execution from one place to another in the program
- **LOOP:** this instruction is to repeat a statement or set of statements a number of times.

### 3.2.2- INSTRUCTION CODE FORMATS

An instruction code format defines the structure of the instruction. A computer has a variety of instruction formats. The instruction code consists of two parts as follows

- **Op-Code** Operation code specifies the type of action to be performed, for example ADD, SUB, MOV, INC, LDA, and STORE etc
- **Operand:** Operands are Actual data for the memory addresses where actual data is placed on which the operation is to be performed

Op-Code	Operand	Memory Address of operand
100 0	010101	011 010

In the above example the Op-Code 1000 specifies the code ADD operation and 0101010110101 specify the operands (values) or memory addresses on which the operands (values) are stored.

### TYPES OF INSTRUCTION FORMATS

Different types of instruction formats are as follows

#### 1- Zero-Address Instruction Format

In zero-address instruction format there is only one op-code. It does not have any operand. Two examples of zero address instruction formats are STOP and HALT.

Example: STOP

Op-Code
---------

#### 2- One-Address Instruction Format

The one-address instruction format uses one op-code and one Operand. Example of one address instruction format is LDA (Load Accumulator) and JMP (Jump). These instructions require one operand (memory address) to do the operation like JMP requires one address in order to jump to that specific address.

Example: LDA

Op-Code	Operand (Address)
---------	-------------------

### 3- Two-Address Instruction Format

The two-address instruction format uses one op-code and two Operands. The Examples of two address instructions are MOV and ADD.

Example: ADD A, B

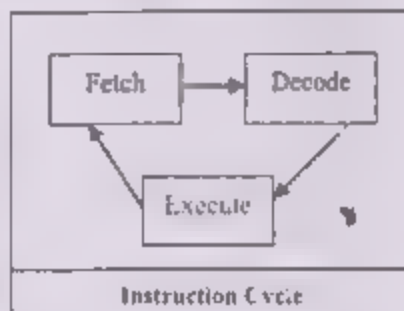
Op-Code	Operand (Address)	Operand (Address)
---------	-------------------	-------------------

### 3.2.3- CPU INSTRUCTION CYCLE MACHINE CYCLE

Each time the Control Unit executes the machine instruction, it takes a series of steps. The complete series of steps is called instruction cycle or machine cycle. The instruction cycle is divided into 3 steps (operations) as follows.

#### i) Fetch

Before the CPU can execute an instruction, the Control Unit must bring the instruction from computer memory to CPU, so reading instruction from memory and transferring it to CPU is called fetch operation.



#### ii) Decode

The process of translating the instruction so that the computer can understand it, is called decoding instruction. CPU decodes the instruction by analyzing the Op Code of the instruction.

#### iii) Execute

After decoding the instruction and getting the data. The process of taking action on the decoded instruction is called execution.

### 3.2.4- ARCHITECTURES

There are two types of CPU architectures as follows

#### 1- CISC Architecture

CISC stands for Complex Instruction Set Computer. It is a traditional type of CPU architecture that supports a large number of instructions. It executes complex instructions very quickly. Intel's 486 and Pentium series are examples of CISC processors.

#### 2- RISC Architecture

RISC stands for Reduced Instruction Set Computer. It only contains the most frequently used instructions. It executes simple instructions very quickly. RISC architecture uses less power and it is inexpensive than CISC processors. IBM PowerPC, Sun SPARC, mobile phones and tablet PCs are examples of RISC.

**Difference between CISC and RISC Processors**

	<b>CISC</b>	<b>RISC</b>
1)	CISC stands for Complex Instruction Set Computer.	RISC stands for Reduced Instruction Set Computer.
2)	Executes more complex instructions than RISC.	Executes Simple instructions than CISC
3)	Slower than RISC	Faster than CISC
4)	Commonly used in Personal Computers.	Commonly used in tablets smart phones etc
5)	CISC has more instructions than RISC	RISC has fewer instructions than CISC

**3.2.5- INTEL AND AMD PROCESSORS**

Intel and AMD (Advanced Micro Devices) are the most popular manufacturers of processors. They manufacture the processors for different devices such as desktop computers, laptops, and mobile devices. Each type of processors perform different task at different speed. Some of the popular processors of Intel are Core, Pentium, Celeron, Xeon and Itanium series. Some of the popular processors by AMD are Phenom, Athlon and Sempron.

**Intel Pentium IV Processor:** Intel Pentium IV process has the execution process of 20 steps. It has higher clock speed. It performs fewer operations per clock. Pentium processors typically have the sockets of 478 pins.

**AMD Processor:** AMD processor has the execution process of 10 steps. AMD processors typically have the sockets of 462 pins.

**Comparison of Intel and AMD Processor**

Feature	Intel Processor	AMD Athlon
Clock Speed	1.7 to 3.0 GHz	1.4 to 2.33 GHz
Bus width	32-64 bits	32-64bits
Cache	256 KB to 1 MB	256-5.2 KB
Architecture	CISC and RISC	RISC

←—————→

**MULTIPLE CHOICE QUESTIONS**

**Q) Select the best answer of the following MCQs**

- Which part of computer performs fetch, decode and execute cycle?  
A- ALU    B- Control Unit    C- Output Unit    D- Registers
- Where are the results of ALU operations transferred?  
A- Counter register    B- Base register    C- Data register    D- Accumulator register
- Which of these buses selects a memory word for a read or write operation?  
A- Data bus    B- Control bus    C- Address bus    D- System bus
- Which of these registers controls the sequence in which instruction is fetched from memory for execution?  
A- Program counter    B- Memory Buffer Register    C- Data register    D- Counter register



- 6) Which instruction causes transfer of instruction execution to a specified address?  
A- Comparison B- Branch C- Split D- Data Movement instruction
- 7) Which of these instructions will perform addition of two numbers?  
A- Data Processing Instruction B- Shift instruction  
C- Comparison Instruction D- Operation instruction
- 8) Through which bus, instructions are transferred from main memory to instruction register?  
A- Control bus B- Address bus C- Instruction bus D- Data bus
- 9) How many distinct operations can be performed if a block of microprocessor consists of 4 bus?  
A- 4 B- 8 C- 16 D- 32
- 10) Which part of computer decodes instructions?  
A- ALU B- Micro memory C- Program Counter D- Control Unit
- 11) CPU includes all the following components except  
A- RAM B- ALU C- Program Counter D- Register
- 12) Which register contains the address of the next instruction in memory to be executed?  
A- PC B- IR C- MBR D- TMP
- 13) Which register holds the "instructions to be fetched by the computer?"  
A- MAR B- IR C- MBR D- PC
- 14) What does a data bus carry?  
A- Data B- Data and instructions C- Address D- Data and address
- 15) Which of the following instructions transfer data from memory location to a register, register to a memory location and register to register?  
A- LD B- STO C- JMP D- MOV
- 16) CPU sends timing and control signals to different components of computer through  
A- Data bus B- Address bus C- Control bus D- Expansion bus
- 17) Which of the following is the program counter instruction?  
A- Loop B- MUL C- JMP D- A and C
- 18) A group of bits that tells the computer to perform a specific operation is known as  
A- Instruction code B- Micro operation C- Vector data D- Register
- 19) Which of the following is the example of zero address instruction format?  
A- STOP B- MOV C- ADD D- LDA
- 20) Which computer architecture executes the instructions faster?  
A- CISC B- RISC C- MUL D- ISA

### Q No. 1.(b) Write TRUE or FALSE.

Statement	TRUE or FALSE
1. CU consists of 3 components.	
MAR stands for Memory Addressed Register	
Data bus is a uni-directional bus	
The process of translating instructions is known as decoding	
AMD and Intel are the popular manufacturers of network devices	

### EXERCISE QUESTIONS

#### Q2. Write short answers of the following questions

1. What is microprocessor? (Ans is on page 41)
2. What is the function of ALU in the computer system? (Ans is on page 41)
3. What is the function of CPU in computer system? (Ans is on page 41)

- 4- Define Bus. *(Answer is on page 44)*
- 5- Define register. *(Answer is on page 42)*
- 6- Define cache memory. *(Answer is on page 42)*
- 7- What is meant by instruction code? *(Answer is on page 45)*
- 8- What is operation code? *(Answer is on page 45)*
- 9- What is the advantage of using address mode in an instruction?  
**Ans.** The advantage of using address mode in an instruction is that we can reference a large range of locations of main memory
- 10- Differentiate between CISC and RISC? *(Answer is on page 48)*

**Q3. Write long answers of the following questions**

- 1- Describe general purpose & special purpose registers.  
*(Answer is on Page 43)*
- 2- Explain the types of buses used in computers. *(Answer is on Page 44)*
- 3- Describe the types of CPU instructions. *(Answer is on Page 47)*
- 4- Explain different types of instruction formats with examples.  
*(Answer is on Page 46)*
- 5- Explain CPU instruction cycle *(Answer is on Page 47)*

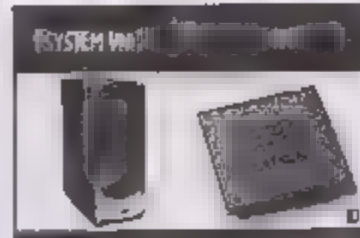
## UNIT 4

### INSIDE SYSTEM UNIT

#### 4.1- SYSTEM UNIT / COMPUTER CASING

##### 4.1.1- CPU AND SYSTEM UNIT

Normally people incorrectly use the word CPU for system unit. Actually CPU is the microprocessor that is installed on the mother board whereas system unit contains motherboard, hard disk, DVD, RAM, and Power supply etc.



##### 4.1.2- COMPUTER CASING

Computer casing is just a box that contains most of the components of computer system. Computer casings are of two types as under:

- **Desktop casing:** The desktop casing is placed flat on the desk or table. The monitor is placed on the top of it.
- **Tower casing:** The tower casing is placed vertically. The monitor is placed next to the casing. It is the most commonly used type of casing.



Desktop casing VS Tower Casing

##### 4.1.3- COMPONENTS OF SYSTEM UNIT

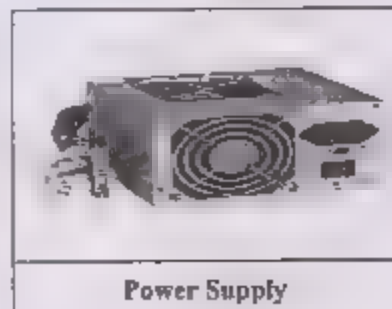
Following are the main components of system unit:

- 1- Casing
- 2- Power Supply
- 3- Motherboard

1- **Casing** (discussed above)

##### 2- Power Supply

The purpose of power supply in a computer is to convert Alternating Current (AC) to low voltage Direct Current (DC) because the power (current) from the wall outlet is Alternating Current (AC) and the components of the computer system require Direct Current (DC). It also decreases the voltage to the level that is required for the computer.

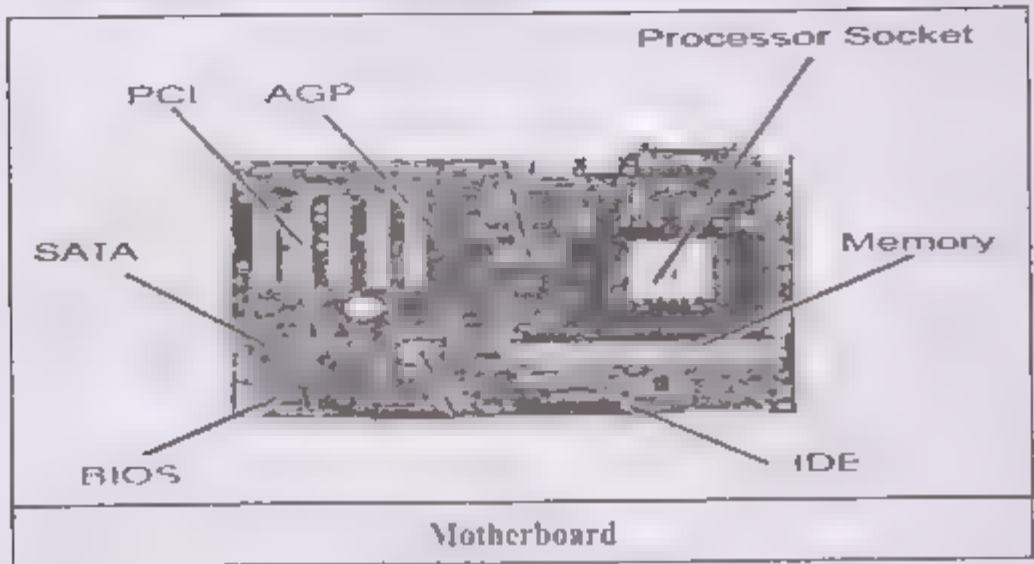


Power Supply

##### 3- Motherboard

Mother board that is also known as system board or main board is a communication medium among all the components of entire computer system. It contains different

sockets, slots and ports on it. Some important components / parts of motherboard are as follows.



follows.

- **CPU socket:** It is used to locate processor on the motherboard. The processor is mounted on the motherboard through CPU socket. It is also known as processor socket.
- **Expansion slot** – It is used to connect expansion cards on the motherboard.
- **Memory slot:** A memory slot, also known as memory stick, allows computer memory module (RAM) to be inserted into the computer. It is used to hold memory modules on the motherboard. Depending on the motherboard there may be two to four memory slots.
- **Disk controller** – It is a circuit which enables the CPU to communicate with the hard disk drive, floppy disk drive, or other kind of disk drives.
- **BIOS:** A chip used to store the program that is used for boot-up the computer.
- **Bus:** Parallel wires on the motherboard that is used to send the data from one component of computer to other. There are three types of buses that include data bus, address bus and control bus.
- **Port** – A connection point through which the external devices (peripheral devices) are connected to the computer.
- **Cooling system.** – It is used to maintain the temperature inside the system unit.

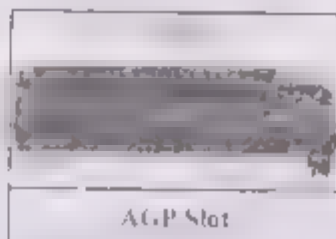


## BIOS

It stands for Basic Input Output System. It is also known as ROM chip. The program embedded on this chip is called firmware. The firmware program has two purposes. First, it is used to determine what peripheral devices like keyboard, mouse, disk drives, printers, video cards, etc. are available and loading the operating system (OS) into main memory. Second, after start up, the BIOS program controls the basic input/output operations of all the peripheral devices attached to the computer. We can use BIOS setup utility to configure the computer hardware, select boot device, set password, set the clock and enable or disable components of computer.

## EXPANSION SLOT

Expansion slot is a long narrow socket on the motherboard that is used to add the expansion card to increase the capability of a computer system. Different expansion cards are fixed on expansion slots on the motherboard. In modern computers, the circuitry of many of these cards is integrated on the motherboard that reduces size and cost. Commonly used expansion slots are AGP (Accelerated Graphic Port), PCI (Peripheral Component Interconnect), PCIe (Peripheral Component Interconnect express).



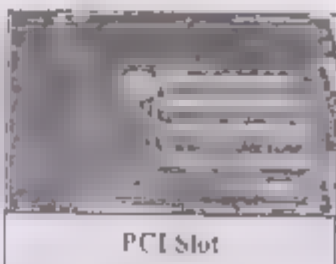
AGP Slot

### • AGP

AGP stands for Accelerated Graphic Port. It is a type of port that was specifically designed for video graphics cards. It provides a high-speed bus for attaching video card to motherboard.

### • PCI

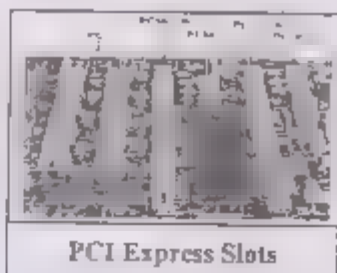
PCI stands for Peripheral Component Interconnect. It is a type of port that is used to attach different expansion cards such as modem card, network card, graphics card and sound card. The PCI slot has been one of the most common types of expansion slots in the past years. It is still used in some computers but gradually it is replaced by PCI express slot.



PCI Slot

### • PCI Express

PCI Express (PCIe) is replacing PCI and AGP slots. Nowadays it is the most commonly used expansion slot found in modern computers. PCI Express is faster than PCI and AGP slot, that is why it is preferred for different expansion cards.



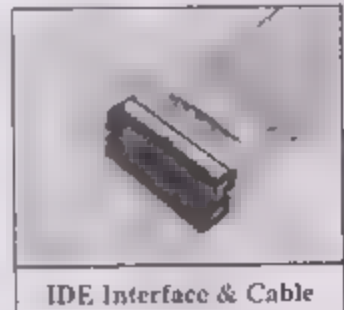
PCI Express Slots

## RIBBON CABLE

A ribbon cable is a thin flat cable consists of several parallel wires. It looks like a ribbon. It is used internally to connect hard disk and optical disc drive etc. Following are the commonly used types of ribbon cable and interfaces.

- **IDE Interface And Cable**

The IDE (Integrated Drive Electronics) is an old interface and cable that was used to attach hard drives to the motherboard. It was used in 1986 for the first time to attach the hard drive in Compaq PC. The hard drive with IDE interface had the drive controller integrated into the drive. An improved version of this interface was introduced in 1994 that was known as Enhanced IDE (EIDE).



IDE Interface & Cable

- **SATA Interface And Cable**

The SATA (Serial Advanced Technology Attachment) interface is used to attach hard drives and optical disc drives to the computer. It was introduced in 2003 that replaced EIDE interface. Nowadays it is used in desktop and laptop computers. The drives with SATA interface communicate via a very high speed cable. SATA interface provides much faster and more efficient data transfer rate than EIDE interface. It uses smaller size of cable and is less expensive. Different version of this interface includes SATA 1, SATA 2 and SATA 3.



SATA Interface &

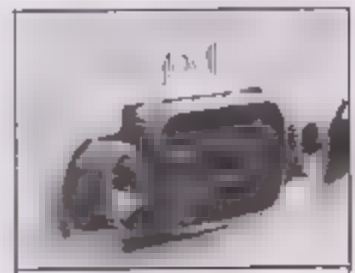
## 4.2-PORTS, EXPANSION CARDS AND MEMORY CHIPS

### 4.2.1- PORT

The physical interface between system unit and peripheral devices is called a port. It is a connection point between the system box and the external devices. It allows us to plug in a cable to connect a peripheral device such as keyboard, monitor, printer etc. so that they can communicate with the computer system. Most computers have several types of ports with different capabilities and uses. Some of them are as follows:

- **Serial Port**

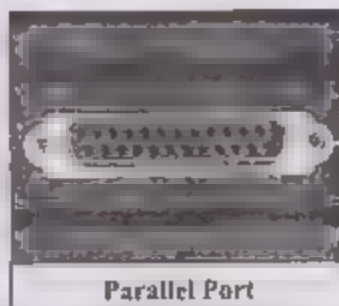
Serial Port allows serial transmission of data i.e. one bit at a time. It is an older port that was normally used to connect modems to computers. Serial port had 9 to 25 pins in which one pin was used to transmit data



These ports have been replaced by USB ports. Serial ports were also known as COM1, COM2, and COM3

- **Parallel Port**

Parallel port allows parallel transmission of data i.e. several bits are transmitted at a time. This port is much faster than serial port. It is also an older port that was usually used to connect devices that requires fast data transmission like printer and scanner. These ports had 25 pins in which 8 pins were used to transmit data and remaining was used to transmit signals. Parallel ports were known as LPT1, LPT2, and LPT3



Parallel Port

- **PS/2 Port**

PS/2 stands for Personal System 2. It was a rounded shape port that was used to connect keyboard and mouse to computer system.



PS/2 Ports

- **USB Port**

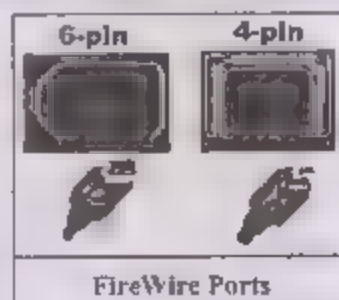
USB stands for Universal Serial Bus Port. It is the most commonly used ports. It is used to connect different devices to computer system such as keyboard, mouse, digital camera, scanner and printer etc. It allows connecting up to 127 peripheral devices at a time. It is a plug-n-play port, means it automatically detects the type of device that is attached to the computer and automatically installs the driver for it or prompts the user to install it. Modern USB provides a data transfer speed of 4.8 Gbps



USB Ports

- **Fire Wire Port**

Fire wire port is used to connect video device such as camcorders to the computer. It can also be used to provide power to some devices. It is a rectangular shaped small port that has four to six pins. The six pins port uses two extra pins to provide electrical power to the device.



FireWire Ports

- **HDMI Port**

HDMI stands for High Definition Multimedia Interface. It provides audio-video interface for transmitting digital data to various devices.



HDMI Port

Nowadays all the modern high definition equipment including PCs, laptops, digital cameras, TV sets, DVR (Digital Video Recorder) have at least one HDMI port.

#### 4.2.2- EXPANSION CARDS

Expansion card is a circuit board that is used to add extra functionality to a computer. It connects additional peripheral devices to the computer. It is inserted into an expansion slot on the motherboard. A motherboard has different expansion slots that are used to connect different expansion cards. Expansion card is also known as adapter card or add-on card.

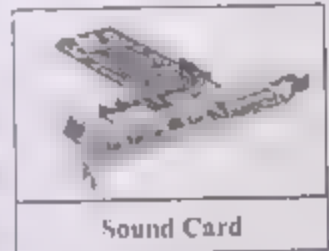
#### TYPES OF EXPANSION CARDS

Four types of expansion cards are commonly used in computers that are as follows:

- 1- Sound Card
- 2- Video Graphic Card
- 3- Modem Card
- 4- Network Interface Card

##### 1- Sound Card

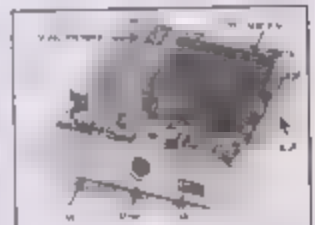
A sound card is used to provide connections for microphone to input sound and for speaker to produce output sound. Without a computer sound card, you produce the sound on beep. At the insertion of sound card in USB, the computer can store and play different sound waves. The input of sound card takes sound inputs sound in the form of analog waves through the microphone and then converts into digital form so that it can be processed in the computer. It outputs sounds through speakers or telephone. Most of the computers include sound card in the expansion slot or it is also integrated on the motherboard.



Sound Card

##### 2- Video Graphic Card

A video graphic expansion card is used to display graphics, images and videos on the screen. Earlier video cards were installed in expansion slots. Now in modern computers, video hardware is integrated on the motherboard called integrated graphics or on-board graphics. Integrated graphics uses some of the computer's RAM and reduces the total RAM capacity. Most of the video cards today come with a dedicated memory called video memory of 256 MB (Mega Bytes) to 2 GB (Giga Bytes). These cards are required to run modern graphics applications and latest video games.



Video Graphic Card

### 3- Modem Card

MODEM stands for MODulator-DEModulator. It is a communication device that is used to send and receive data from one computer to another on the internet through telephone lines or other communication lines. Modem cards are fixed in the expansion slots and some are integrated on the motherboards.

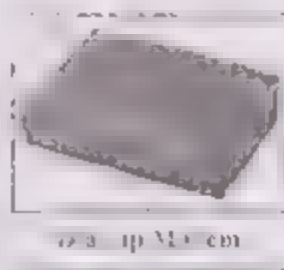


### TYPES OF MODEMS

Following are the common types of modems

- **Dial-up Modem**

Dial-up modem is a communication device that uses telephone lines. They can provide transmission speed up to 56 Kbps (Kilobits per second) which is very slow communication speed that is why it is not used nowadays.



- **ISDN Modem**

ISDN modem is a communication device that uses ISDN services to send and receive data. The word ISDN stands for Integrated Services Digital Network. Here "integrated" means combination of voice and data services over the same line. It uses the same phone lines that are used by dial-up modem. ISDN provides the data transfer rate up to 128 Kbps.



- **DSL Modem**

DSL stands for Digital Subscriber line. It is a communication device that uses DSL services to send and receive data. These modems are more advanced compared to dial-up modems and ISDN modems. They provide extremely fast internet speed depending upon the package and services of ISP (Internet Service Provider). It also uses telephone lines for communication. DSL modem provides the data transfer speed of 384 Kbps to 20 Mbps. Dial-up and ISDN modems are replaced by DSL modems due to high-speed internet connection.



### 4- NIC (Network Interface Card) / Network Adapter Card / Ethernet Card

Network interface card also known as Network adapter or LAN card is an expansion card that is used to connect a computer to a network. Each computer must have a network card in order to communicate with other computers on a network.

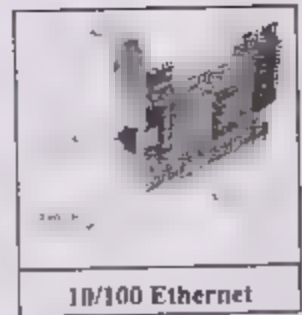


## TYPES OF NETWORK INTERFACE CARD

Following are the common types of network interface card

- **10/100 Ethernet Card**

The 10/100 Ethernet card provides data transfer speed of 10 to 100 Mbps. The PCI or PCIe slot is used to attach 10/100 Ethernet card to the computer. It is normally used at homes and in small offices.



- **Gigabit Network Card**

The Giga bit network card provides data transfer speed up-to 1 Gbps. The PCIe slot is used to attach gigabit network card to the computer. It is normally used at large organizations like universities where very fast speed is required for computers to communicate with each other.

- **Wireless Network Card**

The wireless network card is used to design wireless network. The data transfer speed of wireless network card is typically slower than wired network cards. Wireless network card is normally attached to computer with PCIe slots or USB ports. It can be used at homes or small offices.



## 4.2.3- MEMORY CHIPS /MEMORY MODULE

Memory module is a small circuit board that is used to hold Memory chip (i.e. RAM chip). Today most of the computers have slots for two to four memory modules. The two types of memory modules are SIMM and DIMM.

- **SIMM:** SIMM stands for Single Inline Memory Module. It is a small circuit board that contains memory chips on it. It is plugged into a memory slot on the motherboard. SIMM chips typically use the 32 bit bus. SIMM was used in older computers during 1980's and 90s.

- **DIMM:** DIMM stands for Dual Inline Memory Module. It is a small circuit board that contains memory chips on it. It is plugged into a memory slot on the motherboard. It provides faster data transfer speed and better features because it typically uses the bus up-to 64 bit. Most of the computers today use DIMM.



## VARIATION OF DRAM

Different variation of Dynamic RAM chips are as follows.

- **SDRAM:** SDRAM stands for Synchronous Dynamic Random Access Memory. It is an improved form of DRAM and much faster than DRAM. It synchronizes itself with the computer system clock speed so that the computer's CPU bus speed is optimized for it. It transmits one word of data per clock cycle. Most personal computers today use SDRAM.
- **DDR SDRAM:** DDR SDRAM stands for Double Data Synchronous Dynamic Random Access Memory. It provides improved memory clock speed than SDRAM. It reads and writes 2 words of data per clock cycle. It is inexpensive and consumes less power. The latest types of DDR SDRAM are known as DDR 2 and DDR 3. DDR2 can read and write 4 words per clock cycle and DDR 3 can read and write 8 words per clock cycle time.

### MULTIPLE CHOICE QUESTIONS

**Q) Select the best answer of the following MCQs**

- 1) Which port is generally used to connect video devices to the computer?  
A- Fire Wire port    B- USB port    C- PS-2 port    D- Parallel port
- 2) What is the computer casing with all the components installed inside is called?  
A- Computer System    B- CPU    C- Motherboard    D- System Unit
- 3) What is the interface that provides connection to external devices called?  
A- Expansion Slot    B- Memory Slot    C- Disk Controller    D- Port
- 4) Which of the following provides interface to the network?  
A- NIC    B- Modem    C- Parallel port    D- BIOS
- 5) Which part of computer protects and organizes all the main parts of a computer?  
A- Power Supply    B- Motherboard    C- Casing    D- Expansion Slot
- 6) What is the purpose power supply in the computer?  
A- to convert low-voltage to high voltage    B- to convert DC to AC  
C- to convert AC to low-voltage DC    D- to generate power
- 7) Which circuit board connects all the components of the computer?  
A- Motherboard    B- Ports    C- Network Card    D- Cables
- 8) What is BIOS?  
A- Programs in RAM    B- Port    C- Interface    D- Non-Volatile ROM chip
- 9) Which of these provides high speed channel for attaching video card to motherboard?  
A- IDE interface    B- AGP    C- Disk controller    D- Memory slot
- 10) Which card displays text, graphics and images on the screen?  
A- Network card    B- Gigabit card    C- Modem Card    D- Video graphics card
- 11) The main circuit board in the system unit is called?  
A- Clipboard    B- Motherboard    C- Bus board    D- Chipboard
- 12) Which of the following components holds ROM, RAM and CPU?  
A- Power supply    B- Motherboard    C- CPU socket    D- Expansion slot
- 13) Which of the following is NOT a type of motherboard expansion slot?  
A- AGP    B- PCI    C- PCI express    D- ATX

- 17) Which port is used to connect a device to the system unit by transferring data at a time  
 A- USB B- FireWire C- Serial D- Parallel
- 15) Which port is typically known as parallel port?  
 A- DVI B- COM1 C- LPT1 D- SCSI
- 16) Which port is used to connect the processor on the mother board  
 A- PCI B- CPU socket C- CPU socket D- Expansion slot
- 17) Which port is used to connect the device driver for  
 A- Plug and play B- Plug and play C- Plug and continue D- Plug and commence
- 18) The older hard drives used \_\_\_\_\_ ribbon cable.  
 A- IDE B- SATA C- PCIe D- AGP
- 19) Which port is used to transfer data between computers via telephone lines?  
 A- MODEM B- Multiplexer C- Codex D- PCI
- 20) DSL stands for  
 A- Direct Service Lease B- Domain Server Link  
 C- Distance Service Line D- Digital Subscriber Line

### Q.No. 1 (b) Write TRUE or FALSE.

Statement	TRUE or FALSE
_____ contains motherboard, hard disk etc	_____
_____ expansion slot is used to hold the expansion card	_____
_____ connects a computer to a network or another computer	_____
_____ connecting wireless devices	_____
_____ transfer speed from 384 Kbps to 20 Mbps	_____

## EXERCISE QUESTIONS

### Q. 1. Answer any five of the following questions

1. Define computer casing and describe its types. (Answer is on page 51)
2. Differentiate between computer casing and system unit (Ans is on page 51)
3. What is the function of power supply in the computer? (Ans is on page 51)
4. Define motherboard. (Answer is on page 51)
5. What is the function of BIOS in the computer? (Answer is on page 53)
6. What is the function of disk controller in the computer?

Ans: A disk controller consists of a chip and electronic circuits. It controls the communication between the disk drive and other components of the computer. It may be a separate circuit board or integrated into the disk drive such as SATA.

- 9- Differentiate between SIMM and DIMM. *(Answer is on page 58)*
- 10- Give one advantage and two disadvantages of using wireless network card.

Ans. **Advantage:**

- i- It is easier to setup as no cables are required.

**Dis-Advantages:**

- i- It provides slower data transfer rate.  
ii- It provides lesser security

**Q3. Write long answers of the following questions**

- 1- Explain IDE and SATA interfaces. *(Answer is on Page 54)*
- 2- Describe the following. *(Answer is on Page 54-55)*  
i) Serial Port ii) Parallel port iii) PS 2 port iv) USB port v) Fire wire port
- 3- What are the functions of following expansion cards?  
*(Answer is on Page 56-57)*  
i) Sound card ii) Video display card iii) Modem card iv) NIC
- 4- Explain different types of modems. *(Answer is on Page 57)*
- 5- Describe commonly used Network Interface Cards (NICs).  
*(Answer is on Page 58).*

## UNIT 5

### NETWORK COMMUNICATION AND PROTOCOLS

#### **5.1- COMPUTER NETWORK**

Two or more than two interconnected computers nodes<sup>8</sup> that share the resources are known as a computer network. Computer network consist of computers, some other devices, the physical or wireless connections between them and the software required to enable them to communicate with each other and share the resources. The resources may be hardware and software such as printers, hard disk and programs etc.

Computer networks are commonly used in every field of life to conduct personal and business tasks. The day-to-day transactions at departmental stores, banks reservations counters and other businesses are all dependent upon computer networks.

On a network computer play one of two roles as follows

- **Server computer:** Computer on the network that offers or shares their resources for other computers is known as a server.
- **Client computer:** Computer on the network that accesses resources, which are being shared by other computer, is known as client computer or simply client.

#### **BENEFITS / ADVANTAGES OF NETWORK**

- 1- The main advantage of a network is information sharing. Without a network it is quite difficult to share the information. With the help of network we can share and transfer the information from one point to another.
- 2- Hardware resources such as printer, hard disks etc. can also be shared over the network. Printers and hard disks are relatively expensive devices. As a result sharing printer or hard disk became a primary use of networks. Apart of printer and hard disk other hardware devices can also be shared over a network and used by a number of computers on a network.
- 3- We can share expensive devices such as printers, plotters, scanners, and hard disks etc. to multiple users of networks which saves large amount of money. Fewer devices also mean fewer maintenance charges, services charges and upgrade cost.
- 4- We can keep the backup of each and every transaction<sup>9</sup> in different computers on a network, so that if one computer gets out of order the data can be recovered from other.

<sup>8</sup> Any device connected in the network is known as a node.



5. People use computer networks to conduct personal and professional business transactions.

### 5.1.1- BASIC COMPONENTS / ELEMENTS IN NETWORK COMMUNICATION

The basic components in network communication are as follows.

- **Sender**

The sender is a computer device that is used for sending the message. It is also known as transmitter or source.

- **Message**

Message is the data or information that is to be transmitted. The message may consist of text, numbers, pictures etc. It can also be in the form of audio, video, or a combination of these.

- **Medium**

Transmission Medium is the path through which data travels from one location to another. If the receiver and transmitter both are within the same building then commonly wired medium is used to connect them. If they are located at different locations then they are connected by means of telephone lines, fiber optics, microwaves and satellite etc.

- **Receiver**

The receiver is a computer device that is used for receiving the message. The device could be a computer, printer or it can also be a telephone handset or television set. The receiver is also known as destination.

- **Protocol**

Protocol is a set of rules for the exchange of data between computers. It represents an agreement between the communicating devices. It must be installed in the computer device otherwise the devices on the network cannot communicate with each other without protocol.

### 5.1.2- NETWORK / DATA COMMUNICATION MODES

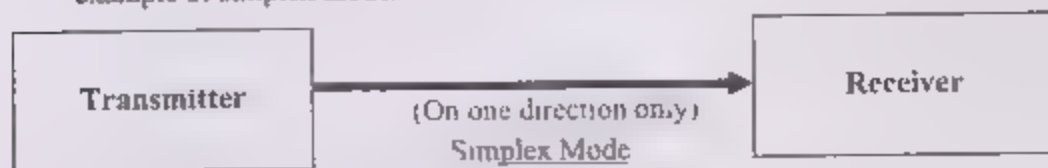
Mode of data communication means the way in which the process of data communication takes place. Data communication modes depend upon the nature of transmitting device, receiving device and medium. There are three modes of communication as follows:

#### 1- Simplex Mode

In this mode of communication the data is transmitted in only one direction from a sender to receiver. Moreover, the receiver cannot transmit the data back to the sender.

Examples of simplex mode are as follows:

- i- Television broadcasting in which the signal is sent from transmitter to TV antenna. There is no return signal
- ii- Transmission from computer to printer and keyboard to computer is also example of simplex mode.

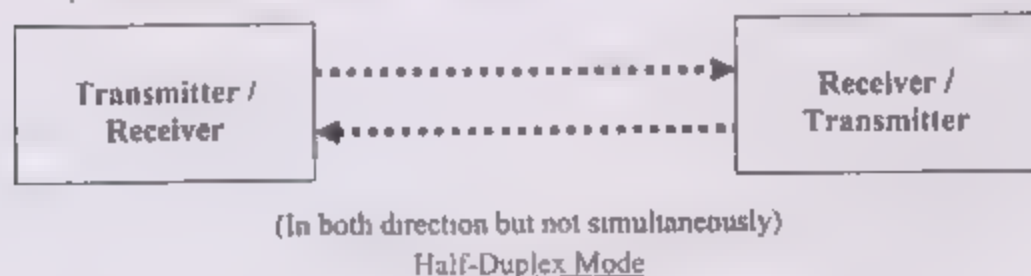


## 2- Half-Duplex Mode

In a half-duplex mode the data can be sent and receive in both directions but not at the same time. The signals can only be sent or received at the same time. In this mode both the points act as transmitter as well as receiver. Police wireless set works on half-duplex mode.

Examples of half-duplex mode are:

- i- A walkie-talkie communication is an example of half-duplex mode. It allows only one person to talk at a time and each of the persons communicating must indicate when they finish speaking.
- ii- Communication between a computer and credit card machine is also in half-duplex mode.

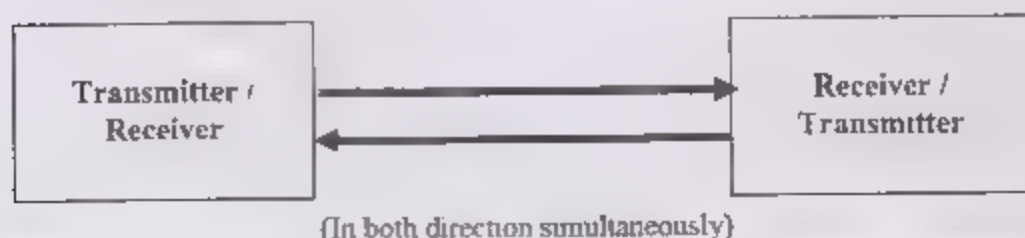


## 3- Full-Duplex Mode

In a full-duplex mode the data can be sent and received in both directions at the same time. A full-duplex line is equal to two simplex lines one in each direction. Full-duplex line is the fastest line because the data can be sent and received simultaneously.

Examples of half-duplex mode are:

- i- Telephone communication works on full-duplex mode. It allows both persons to talk at the same time.

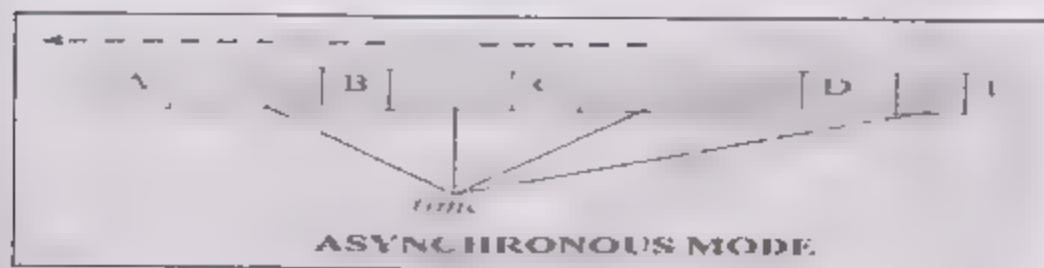


## ASYNCHRONOUS AND SYNCHRONOUS DATA TRANSMISSIONS

Asynchronous and synchronous transmissions are two different methods used for transmitting characters between components within a computer or from computer to other devices such as printer, modem etc.

### 1- Asynchronous Transmission

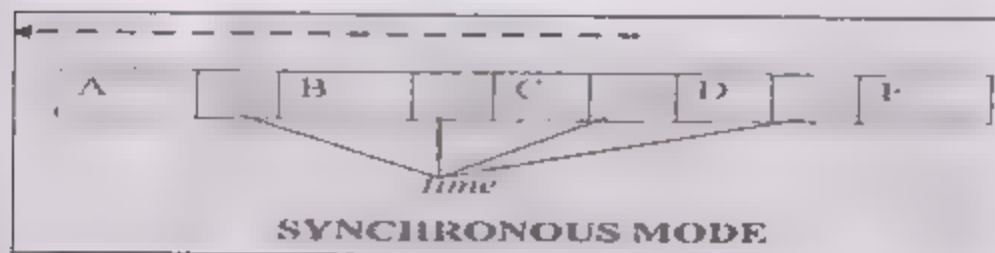
In Asynchronous transmission the characters are transmitted in discrete (irregular



manner and the time interval between the two characters is not fixed. As the data is transmitted in the irregular manner so at the receiving end, it causes a lot of problem to recognize the start and end of the character. In order to overcome this short coming two bits are included in every character that represent the start and the end of character. Usually, the start bit is represented by '0' while the stop (end) bit is represented by a '1'. The data transmission speed in asynchronous mode is slower due to the extra bits involved in the data transmission and the gaps (time delay) between the characters. Keyboard data transmission is an example of asynchronous transmission.

### 2- Synchronous Transmission

In synchronous transmission the data is transmitted character by character in such a



way that the distance (time delay) between every two characters is constant. It is obvious that in synchronous mode the (time delay) between every two character is constant so there is no need of including start and stop bits with each character. As a result, the size of data is decreased and the transmission speed becomes high. However a special idle signal is sent when there is no data to transmit. In this type of transmission some kind of clocking mechanism is also placed to keep the clocks of transmitter and receiver synchronized. Data transmission between devices within the network is an example of synchronous transmission.

**Difference between Asynchronous and Synchronous data transmission**

	Asynchronous Transmission	Synchronous Transmission
1)	The time interval between two characters is not fixed	The time interval between two characters is fixed
2)	The sender and receiver are not synchronized with each other	The sender and receiver are synchronized with each other
3)	It uses extra bits for start and stop to control the data transmission	It uses clock signals to control the data transmission
4)	It is less efficient and slower data transmission method	It is more efficient and faster data transmission method

**5.1.3- COMMUNICATION MEDIA**

Transmission Medium is the path through which data travels from one location to another. They are the links between the communicating devices. Communication media is also known as communication channel. There are two categories of communications media as follows: 1) Guided media 2) Un-Guided media

**1- GUIDED MEDIA**

Guided media is a type of communication media in which the devices are connected with each other using wires or cables. The cables are used to guide the data signal along a specific path. It is also known as physical or bounded media.

**TYPES OF GUIDED MEDIA**

Following are the types of guided media.

- |                    |                       |
|--------------------|-----------------------|
| 1- Telephone Lines | 2- Twisted Pair Cable |
| 3- Coaxial Cables  | 4- Fiber Optics Cable |

**1- Telephone Lines**

Telephone lines are the oldest medium used in communication. The entire world has been interconnected already through the telephone lines, so these lines can also be used for the communication of data between two computers. The disadvantage of telephone line is that the transmission speed is very slow.

**2- Twisted Pair-Cable**

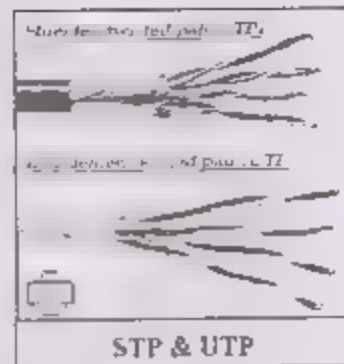
These are commonly used in local telephone communication and for short distance data communication such as in Local Area Network to connect less number of computers. Twisted-pair cable uses one or more pairs of twisted copper wires to reduce noise. The noise is an electrical disturbance that can degrade communication signals. Twisted pair cables support transmission speed from 100 Mbps to 1 Gbps over a distance of 100 meters. There are two types of twisted pair cable as follows

- **Shielded Twisted Pair Cable**

The only difference between shielded twisted-pair (STP) and (UTP) is that STP cable has a shielded layer of foil (usually aluminum foil) between the outer jacket casing and the wires. The STP is expensive but reliable than UTP.

- **Unshielded Twisted-Pair Cable**

Unshielded twisted-pair (UTP) cable consists of a number of twisted pairs with a simple plastic casing. It does not contain a layer of foil shielding to reduce the electromagnetic interference. It is less expensive than STP cable.



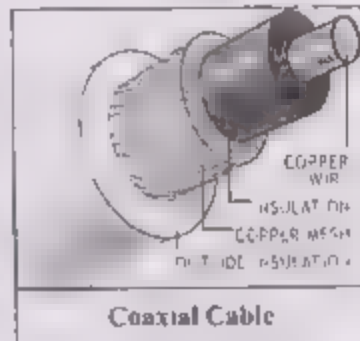
STP &amp; UTP

### Characteristic of Twisted Pair

- It is an inexpensive communication medium
- It is easy to install
- It is used in small networks.

### 3- Coaxial Cable

Coaxial cable is another communication media, which is widely used for cable TV. There are two conductors (made up of copper) in coaxial cable. One is a single wire in the center of the cable and the other is a wire mesh shield that surrounds the first wire with an insulator in between. It is mostly used for long distance transmission. Coaxial cables support transmission speed from 10 Mbps to 100 Mbps for long distance up to 500 meters.

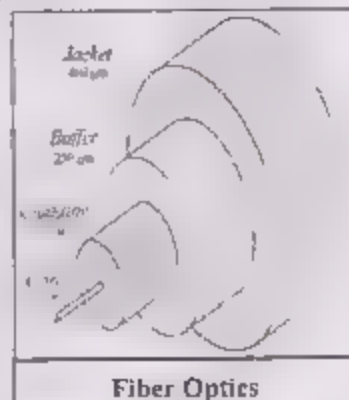


### Characteristic of Coaxial Cable

- Installation of coaxial cable is very easy
- Expensive transmission medium than twisted pair cable
- It covers more distance than twisted pair cable.

### 4- Fiber Optics Cable

Fiber optics cable is relatively new technology that is replacing conventional wire and cable in communication systems. The typical fiber optic cable consists of a number of thin wires of glass called **Core** on which the data is transmitted in the form of light. The thickness of each wire is about the thickness of a hair. The core is



Fiber Optics



surrounded by a concentric layer of glass called **Cladding**. The cladding is further protected by a plastic coating called **Jacket**. Fiber optics provides high quality transmission at a very high speed from 6 Gbps to 100Gbps

### Characteristics of Fiber Optics Cable

- Data is transmitted in the form of light
- Lighter in weight and smaller in size
- Not affected by electromagnetic interference
- Fastest guided communication medium
- Secure and reliable communication medium

## 2- UN-GUIDED MEDIA

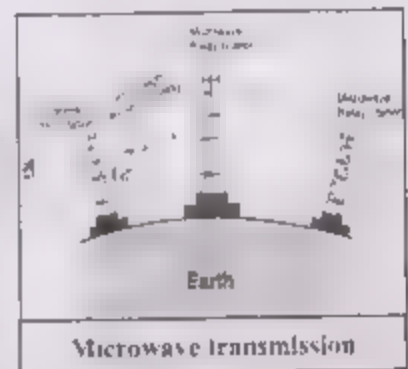
It is a type of communication media in which the devices are connected with each other without wires or cables. It is also known as un-bounded media

### TYPES OF UN-GUIDE MEDIA

Following are the types of un-guided media

#### 1- Microwave Communication

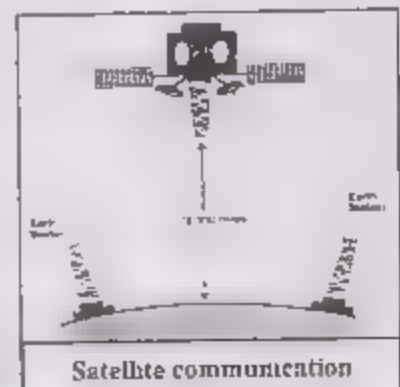
Microwave communication signals travel through open space much like radio signals. They provide a much faster transmission rate than is possible with either telephone lines or coaxial cables. Microwave systems transmit information with transmitters, which are normally installed on high buildings, mountains top or high towers. Long distance microwave channels consist of a series of relay stations (boosters) spaced approximately 30 miles apart. Two stations must be within sight of one another. For transmitting information long distances, signals are amplified and re-transmitted from station to station.



#### 2- Satellite Communication

Satellite communication is quickly gaining importance as a means for data communication. Communication Satellites are positioned in space approximately at 22,000 miles above the earth. These satellites serve as relay stations for the transmission of signals generated from the earth.

Satellites communication is ideal for long distance communication. Earth stations consisting of ground antennas transmit signals to the satellite called uplink.



The satellite amplifies and retransmits the signals to another earth station called downlink, which can be located many thousands of miles away. Transmission by satellite allows large amount of data to be sent long at rapid speeds. Its use has increased dramatically in recent years. However, a major drawback of satellite communication has been the high cost of placing the satellites into its orbits. These satellites are launched either by rockets or by space shuttles and precisely positioned in the space with an orbit speed that exactly matches with the rotation speed of the earth. Therefore, it is stationary relative to earth and always stays over the same point on the ground. This allows a ground station to aim its antenna at a fixed point in the sky.

### 5.1.4- COMMUNICATION DEVICES

A communication device is a hardware device which is capable of transmitting signals over communication media from one location to another. Some commonly used communication devices are Hub, Switch, Router and Gateway.

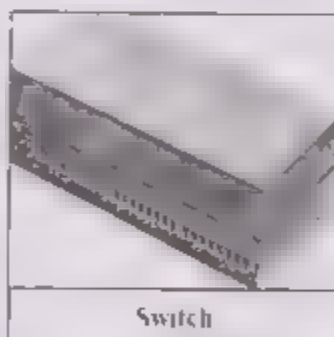
- **Hub**

Hub is a communication device that is used to connect devices in LAN. A hub is a non-intelligent device that broadcast message i.e. it sends information to all the devices connected on the network. A hub has multiple input/output ports. It receives a data packet from the port and sends the packet to all the ports except the port from where it was came.

- **Switch**

Switch is a communication device that connects several devices in a network. It receives a data packet from any device connected to the network and then inspects the packet, determines the source and destination device of each packet and transmits the data packet only to destination device. Switch is also known as intelligent hub.

A data packet is a small piece of data that is transmitted over a network. When data is transmitted, it is broken down into packets which are re-assembled to the original form when they are reached the destination.



Switch

- **Router**

Router is a communication device that is used to connect multiple networks. The main responsibility of a router is to forward data packet over networks choosing a best available path-way using the routing information in its routing table. A router can be used on a network of any size. It can be used to connect a Local Area Network to Internet or it can also be used to connect multiple



Router

- **Gateway**

Gateway is a device that connects two networks working on different protocols platforms. Two different types of networks require a gateway to communicate with each other. It receives data from one network and converts it according to the protocol of other network.

### 5.1.5- NETWORK ARCHITECTURE TYPES OF NETWORK

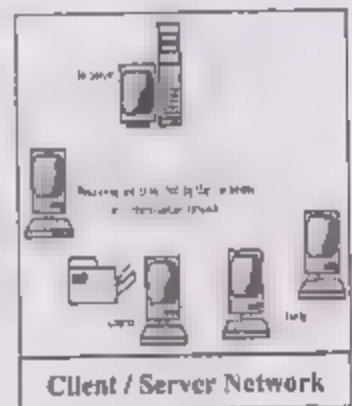
The design of communication system is said to be architecture of network. It includes hardware devices (routers, switches etc), cabling, network topology and physical or wireless connections. The two commonly used network architectures are as follows.

1- Client / Server Network

2- Peer-to-Peer Network

#### 1- CLIENT/ SERVER NETWORK

In a client-server network, one or more computers are dedicated to act as servers and other computers work as clients. The client computers request resources from the server. The server computers provide services to the clients. In this network the client computers never act as server. Client server network provides centralized control of data and other resources. Moreover it provides centralized security to ensure that unauthorized users do not access resources.



#### Advantages

- The servers provide centralized control and management of network
- Less power computers can be used as client computer because most of the processing is done by server computers.
- It provides centralized security

#### Disadvantages

- Server computers are expensive and the server operating system is also expensive.
- If the server computer goes down, the entire network stops to operate
- Expert person (network administrator) is required to look after the server computers activities

#### 2- PEER-TO-PEER NETWORK

In a peer to-peer network, every computer can act as a client, server or both at the same time. In this type of network, each computer is referred to as peer or peer-to-peer.

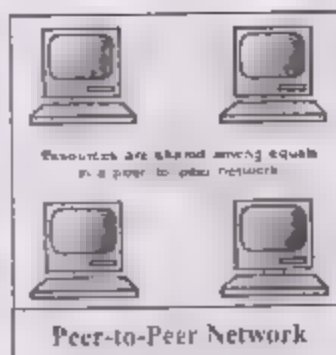
It can also access other shared resources on the network. Large peer-to-peer networks become difficult to manage because so many network administrators are required for sharing and maintaining the resources.

#### Advantages

- Each computer of a network can share and use resources.
- It is easy to maintain.
- It does not require expensive server computers.
- It is suitable for small networks of ten or less computers.

#### Disadvantages

- There is no centralized control and management of network.
- It is less secure network than client server network.
- Large peer-to-peer networks are difficult to manage.
- In large peer-to-peer networks many network administrators are required to control the activities.



### 5.1.6- TYPES OF NETWORK (BASED ON AREA)

Following are the types of network based on physical area

1- LAN

2- WAN

3- MAN

#### 1- LAN

LAN stands for Local Area Network. It is a type of network spread over a limited area of some meters to a kilometer. Usually a LAN is spread within an organization. In other words we can say that a network within a building is known as a LAN.

##### Advantages

- It covers small, physical area therefore easy to manage.
- High speed wired or wireless technology can be used to connect computers.
- It is a reliable network.

##### Disadvantages

- Special security measures are required to ensure network security.
- A skilled person (LAN administrator) is required to maintain LAN.

#### 2- WAN

It stands for Wide Area Network. It is a type of network connecting the cities, states, and countries. It is also known as long-haul network because of its long distances. Internet is the best example of WAN. Computers in a WAN are connected with each other through physical cables and wireless media like microwaves. Two or more interconnected LANs are also said to be a WAN.

**Advantages**

- Covers large physical area, can be worldwide like internet
- People can communicate with one another all over the world
- It connects multiple LANs.

**Disadvantages**

- It is an expensive type of network.
- It provides slower communication speed than LAN
- WAN is difficult to setup and maintain

**3- MAN**

MAN stands for Metropolitan Area Network that is a link between offices buildings in a city or town and covers a smaller geographical area than WAN. It covers an area of approximately 50 km of diameter. MAN is usually used to connect two or more LANs within the city. Cable TV network is one of the examples of MAN.

**Advantages**

- MAN covers larger area than LAN and smaller area than WAN
- MAN uses different communication media such as fiber optics or microwave
- It provides high speed communication

**Disadvantages**

- It is expensive than LAN
- It is difficult to manage as compare to LAN.

**Difference between LAN and WAN**

	LAN	WAN
1,	Covers small geographical area	Covers large geographical area
2)	Computers are directly connected through physical cable or with wireless medium	Computer can be connected through various mediums and technologies
3,	Ethernet card is used for data transmission.	Modem is used for data transmission
4	Data transmission speed is very high	Data transmission speed is low
5	Less possibility of data transmission errors	Higher possibilities of data transmission errors

**Virtual Private Network (VPN)**

Virtual Private Network (VPN), is a private and secure network that provides remote access to users to their organization's network. For example it can be used by a traveling employee to use company's network securely over the internet. It provides cheap communication by using internet instead of any leased line.



**Advantages**

- 1 VPN provides secure remote access to the private network.
- 2 It allows file sharing and video conferencing etc
- 3 Free VPN services provide inexpensive communication over long distance

**Disadvantages**

1. The quality services of VPN are very expensive
2. It is difficult to manage VPN

**5.1.7- NETWORK TOPOLOGIES**

The arrangement of network nodes and connection between them is said to be a network topology. Network topology specifically refers to the physical layout or design of a network. Following are the common network topologies

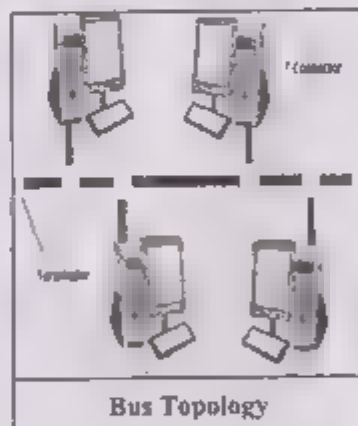
- 1- Bus Topology    2- Star Topology    3- Ring Topology    4- Mesh Topology

**1- BUS TOPOLOGY**

All the computers in Bus topology are connected with each other through a single cable known as a bus. The terminators are attached at both end of the bus to absorb free electrical signals and stop reflecting the signals. Bus topology is the simplest type of network topology that supports small number of computers.

**Working:**

In bus topology the data is sent by source computer to all the computers on the network, only one computer whose address matches with the message accepts the data and all other computers disregard the message

**Advantages of Bus Topology**

- 1- The bus is simple and easy to use.
- 2- It is reliable in small networks.
- 3- The bus requires the least amount of cable to connect the computers
- 4- It is less expensive because a single cable is required to connect computers.
- 5- The bus network is easy to extend, two cables can be joined with a Connector

**Disadvantages of Bus Topology**

- 1 Supports only small numbers of computers.
- 2- If there is a problem with the main cable, the entire network goes down
- 3- Difficult to troubleshoot.

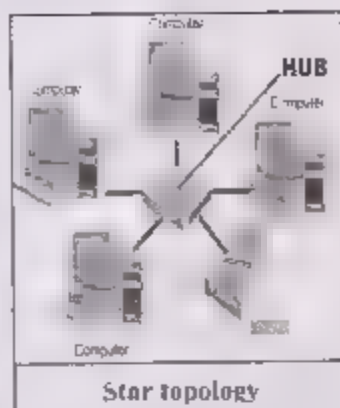
## 2- STAR TOPOLOGY

In a star network topology the computers are connected to a central device called a hub or switch. Hubs

Switches typically have 4 to 48 ports to connect the devices with it. Some networks may require many hubs that are connected to each other to create a single large network.

### Working:

Each computer on a star network communicates with a central device that could be a hub or switch. The source computer sends the data to the central device switch or hub. The central device sends the data to the destination computer only rather than sending it to all the computers.



### Advantages of Star Topology

- 1- Suitable both for small and large networks
- 2- It is easy to modify and add new computers to a star network without disturbing the rest of the network.
- 3- The center of a star network is a good place to diagnose network faults
- 4- Single computer failure does not bring down the whole star network

### Disadvantages of Star Topology

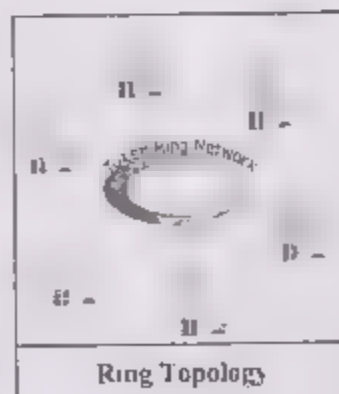
- 1- If the central hub fails, the whole network fails to operate
- 2- Star networks require extra device at the central point to rebroadcast or switch network traffic
- 3- It is expensive network topology because more cables are required to connect the computers to central device.

## 3- RING TOPOLOGY

The ring network topology is shaped just like a ring. It is made up of an unbroken circle of network computers nodes. Each node is directly connected to its two immediate neighbors. A Ring topology is also called a circular bus.

### Working:

Each computer in sequence receives the message from previous computer and passes it to the next computer until the address matches to the address of a destination computer. The message flows in one direction.



**Advantages of Ring Topology**

- 1- The ring is easy to implement.
- 2- There is very rare chances of data lose.
- 3- The ring is less expensive network topology

**Disadvantages of Ring Topology**

- 1- Failure of one node affects the whole network.
- 2- Ring is difficult to troubleshoot.
- 3- Adding or removing computer can stop the activities of the network

**4- MESH TOPOLOGY**

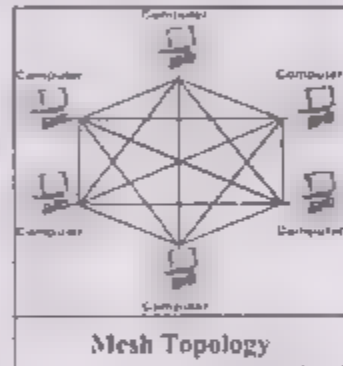
A Mesh topology which is also known as completely connected network has a separate physical link for connecting each node to any other node. Thus each computer of such network has a direct dedicated link, called point-to-point link with all other computers of the network.

**Advantages of Mesh Topology**

- 1- It is the most reliable and fast network topology
- 2- Various routes are available to send information from one point to another
- 3- The network continues to work even if any computer fails to work

**Disadvantages of Mesh Topology**

- 1- It is the most expensive network topology because a lot of cable is required to connect a computer to every other computer.
- 2- Difficult to setup maintain and troubleshoot

**5.2- DATA COMMUNICATION STANDARDS**

Data communication standards are the hardware and software specifications followed by computer systems to communicate with one another. These standards determine how different devices on a network communicate. The term 'standard' indicates that the specification has been approved by a recognized organization.

**5.2.1- Purpose of Data Communication Standards**

The main purpose of communication standards is that they allow the manufacturers to develop the devices that are compatible with other devices. Moreover, the standards ensure successful data communication between different devices.

**ISO**

ISO stands for International Standards Organization that specifies standards for data communication and networks. In the early 1970s the ISO developed standard model of

### 5.2.2- OSI

OSI stands for Open Systems Interconnection. It consists of seven layers. OSI model was developed to facilitate a communication system in which equipment from different vendors can communicate with each other. It also describes the flow of data from one computer to another. The seven layers of OSI model are as under:

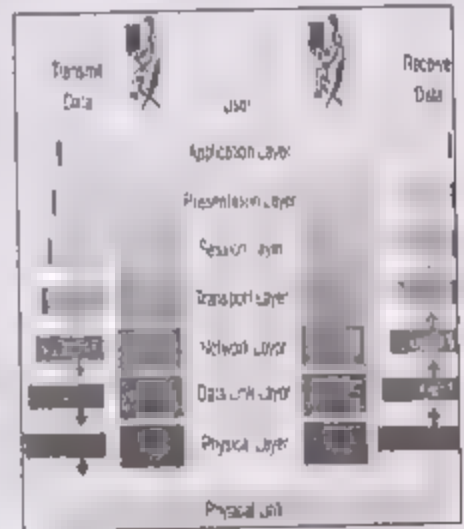
#### Layer 7- Application layer

It is the last or top layer of OSI model, which provides the interface to a user for communication. It provides services directly to user applications. It enables user to access the network. It allows the user to read messages, send files and emails, read messages and perform other tasks over the network.

#### Layer 6- Presentation layer

Following are the main functions of presentation layer:

- **Data Reformatting / Data Compatibility:** Different computers on a large network may use different encoding methods. The presentation layer is responsible for making the data compatible on both source and destination. For example, if the source computer is working on ASCII code formats while the destination computer is working on Unicode, then the presentation layer makes them compatible by providing optimal accuracy.
- **Encryption / Decryption:** Presentation layer encrypts data before transmission. Encryption is a technique used to transform the original information into another form. The information is decrypted at the receiver end.
- **Compression:** Data compression is a technique that is used to reduce the size of original data. Presentation layer compresses a large amount of data into small size.



#### Layer 5- Session layer

It is the fifth layer of OSI model and is responsible for managing the data security to avoid illegal access of data. This layer contains related user name, password, etc. for their verification. The session layer can provide a checkpointing mechanism for the transfer of data. If failure occurs, then only the data from the last checkpoint is retransmitted.

**Layer 4- Transport layer**

It is the fourth layer of OSI model that is responsible of grouping /dividing the data into segments. It ensures that the data received is in the right format and in the right order without any error. The data is retransmitted if there is any error in the transmission. Transport layer also sends an acknowledgement of receiving of data to the sender.

**Layer 3- Network layer**

It is the third layer of OSI model. The responsibility of this layer is to choose the best available route/path to transmit data. It is not necessary that the shortest route must be the best route. A longer idle route will be the best route if the shortest route is too busy to be used. It also provides logical addressing (IP addresses) for computers.

**Layer 2- Data-link layer**

It is the second layer of OSI model, that is responsible of linking data with transmission line. It is also responsible for recognizing errors and controlling the flow of data. In this layer packets are referred to as frames. It also provides the physical addressing i.e. MAC address.

**Layer 1- Physical Layer**

It is the first or bottom layer of OSI model. Following are the main functions of physical layer:

- **Media Characteristics:** The electrical signaling, wiring and signaling standards that defines which pin on a connector does what and what will be the voltage are defined in this layer.
- **Representation of bits into signal.** In computer the data is in the form of 0's and 1's, it must be converted into signals to be sent across the transmission medium. The physical layer converts the bits into signals.
- **Defining data rate:** The physical layer defines the data transmission rate over the transmission medium. It means that physical layer defines the number of bits that will be transferred in each second.
- **Transmission mode:** The transmission mode such as simplex, half-duplex or full-duplex is also defined in physical layer.

**5.2.3- PROTOCOL**

Protocol is a set of rules for the exchange of data between computers. It represents an agreement between the communicating devices. It must be installed in the computer or in the network device, otherwise the devices on the network cannot communicate with each other.



**Protocol and Devices used at various layers of OSI Model**

Layers of OSI Model	Protocol Name	Function	Device used
Physical Layer	X.25 & IEEE 802	Provides hardware such cables and connectors for sending and receiving data	Cables and Connectors
Data Link Layer	X.25 & IEEE 802	Place data packets on to the path way for transmission	Switches & NICs
Network Layer	Internet Packet	Controls routing and forwarding of data between source and destination	Routers
Transport Layer	TCP	Transfers data between source and destination and is responsible for error recovery and flow control.	Routers and Gateways
Session Layer	NetBIOS	Starts and stops communication sessions between applications.	Gateways
Presentation Layer	Windows OS	Converts data into a format that can be carried by the lower layer or converts data into a form that the application layer can understand at the receiving end	Gateways
Application Layer	HTTP	Processes interaction between the end user and software	Gateways

**5.3- TCP / IP Suite**

Communication between computers on a network is done through protocol suite. TCP/IP is the most widely used protocol suite for communication. The US Department of Defense (DoD) was developed TCP/IP in 1969.

**5.3.1- TCP/IP Protocol**

TCP/IP stand for Transmission Control Protocol. Internet Protocol is a suite of protocols that must be installed in the computer to access the internet. In other words we can say that TCP/IP is the language of internet through which the communication between computers becomes possible.

**TCP/IP Architecture / Model**

TCP/IP Architecture Model consists of four layers that are used to transfer data from one computer to another. Following are the layers of TCP/IP model.

1. Application Layer
2. Transport Layer
3. Network Layer
4. Network Access/Interface Layer

OSI Model	TCP/IP Model
Application layer	Application layer
Presentation layer	
Session layer	
Transport layer	Transport layer
Network layer	Network layer / Internet layer
Data link layer	Network Interface layer
Physical layer	

### Comparison between TCP IP model and OSI model

	TCP/IP MODEL	OSI MODEL
1)	TCP IP stands for Transmission Control Protocol Internet Protocol	OSI stands for Open System Interconnection
2)	It has 4 layers.	It has 7 layers.
3)	It was developed by US Department of Defense (DoD).	It was developed by ISO (International Standard Organization).
4)	TCP IP is an implementation of OSI model	OSI is a reference model
5)	Some layers of TCP IP model represent more than one layer of OSI model for example Network Interface Layer of TCP/IP model is represented by two layers in OSI model that are physical layer and data link	Some of the OSI layers are represented by only one layer in TCP/IP model. For example application layer, presentation layer and session layer of OSI model are represented by single layer of TCP/IP model i.e. application layer

### TCP/IP Ports and Applications

An application on the computer sends and receives data over the internet with the help of IP address and on specific logical port. A logical port is an address used to direct the data to the proper destination application. These ports are called TCP/UDP ports. There are 65536 possible TCP/UDP ports. The Internet Assigned Numbers Authority (IANA) is an organization that is responsible for registration of port numbers for the common internet services. Some examples of common ports include HTTP (TCP port 80), HTTPS (TCP port 443) and SSH (TCP port 22).

### 5.3.3- SWITCHING

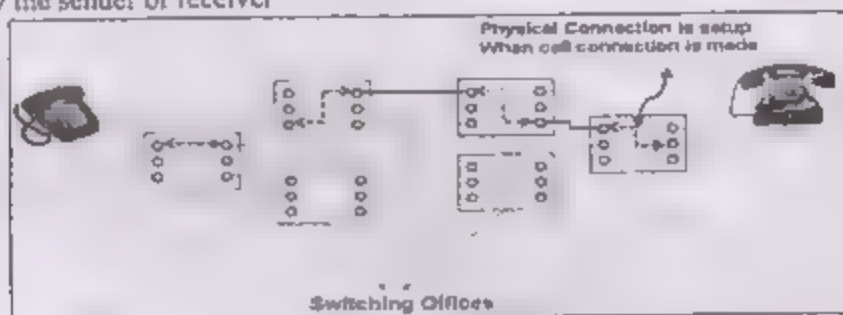
Switching is an important technique that can determine how connections are made and how data movement is handled on a WAN. Data sent across inter-networks with the help of intermediate nodes. These nodes provide switching facility that moves data from node to node until the destination is reached. Following are the major switching networks

#### 1. Circuit Switched Network

#### 2. Packet Switched Network

##### 1- Circuit Switched Network

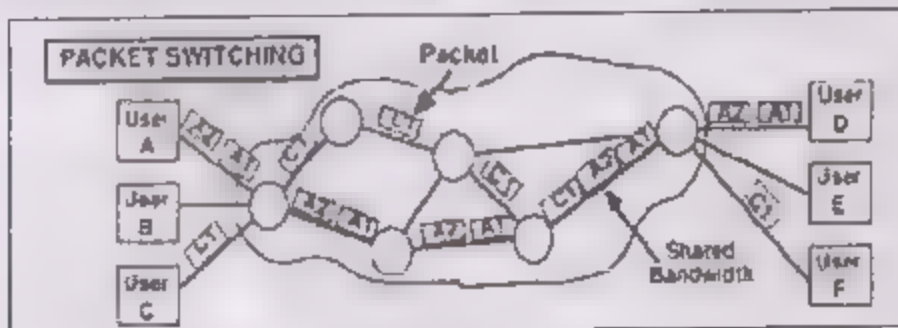
In a circuit switched network a dedicated physical connection is established between the sender and the receiver and maintained for the entire conversation. For example, the old PSTN (Public Switched Telephone Network) was using a circuit switching technique. When a call was made, a physical link between the two phones was dedicated during the entire conversation and existed until the call was terminated either by the sender or receiver.



The major advantage of circuit switching is that once the circuit is established then the data is transmitted with no delay. Since a dedicated point-to-point connection is required between source and destination for the entire duration of conversation, therefore the network resources are not properly utilized.

##### 2- Packet Switched Network

In packet switched network, no physical connection is established however the messages are broken down into small blocks called packets. Each packet includes source



address, destination address, packet number etc. Packet is sent by the source computer to its local Packet Switching Exchange (PSE). Then the Packet switching network sends

it through intermediate nodes along the best route available between source and destination.

Each packet may travel, choosing different available path and the packets composing a message may arrive at different times or out of sequence, so the receiving computer reassembles the packets using the packet sequence to compose an original message. Communication over the Internet is the example of Packet switching.

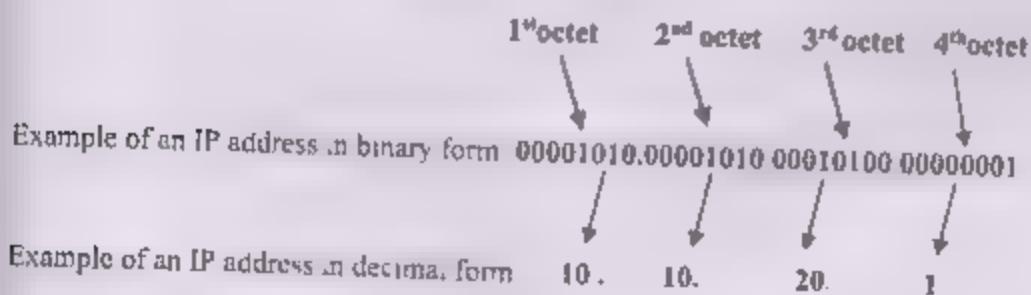
### 5.3.4- IP ADDRESSING SCHEME

IP Address is a unique number that identifies a computer on the network. Each computer on a network must have an IP address in order to communicate with other computers. IP address consists of two parts. The first part identifies the network number and second part identifies the computer number. All computers on a given network share the same network number but must have a unique computer number. Similarly, any two computers on different networks must have different network numbers but may have the same computer number.



#### Format / Structure of IP Address

IP address is a 32 bits (4 bytes) numeric address. The 32 bits are divided into four parts. Each part is known as an octet. One octet is equal to 8 bits. The four octets are separated by dots. Each octet is converted to decimal and separated by a dot. Therefore an IP address is expressed in dotted decimal notation.



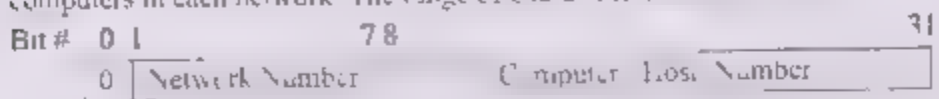
### CLASSES OF IP ADDRESS

The class of an IP address specifies which of the bits in IP address are used to identify the network ID and which bits are used to identify the Host/Computer ID. It also defines the possible number of networks and the number of computer in each network. There are five classes class A, Class B, Class C, Class D and Class E. The three main classes are discussed as follows:

#### 1- Class A

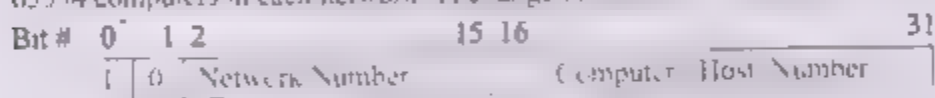
Class A addresses are used for network with a very large number of computers.

are used for computer number. The first bit (most significant bit) in first octet is always set to 0 (zero). This bit and the next 7 bits are used to identify the network number. The remaining 24 bits are used to identify the computers number in the network. It can be used to create  $(2^7) = 128$  networks with  $(2^{24}) = 16,777,216$  computers in each network. The range of Class A IP address is 0-126.



### 2- Class B

Class B addresses are used for medium sized to large sized network. In Class B IP address first two octets are used for network number and remaining 2 octets are used for computer number. The first two bits (most significant bits) in first octet is always set to 10 (one zero). These two bits and the next 14 bits are used to identify the network number. The remaining 16 bits are used to identify the computers number in the network. It can be used to create  $(2^2) = 16,384$  networks with  $(2^{16}) = 65,536$  computers in each network. The range of class B IP address is 128-191.



### 3- Class C

Class C addresses are used for network with small number of computers. In Class C IP address first three octets are used for network number and remaining 1 octet is used for computer number. The first three bits (most significant bits) in first octet is always set to 110 (one one zero). These three bits and the next 21 bits are used to identify the network number. The remaining 8 bits are used to identify the computers number in the network. It can be used to create  $(2^3) = 2,097,152$  networks with  $(2^8) = 256$  computers in each network. The range of Class C IP address is 192-223.



**Note** When calculating IP addresses 2 IP addresses are decreased in every class because they cannot be assigned to hosts/computers i.e. the very first IP of a network number and the very last IP is reserved for broadcast.

### SUBNET MASK

The second main item that is required for TCP/IP to work is subnet mask. It is another 32 bit number for example 255.255.255.0 is a subnet mask and its binary equivalent is 11111111.11111111.11111111.00000000. The purpose of using subnet



mask is to identify the network portion and computer host portion in an IP address. Class A, B and C networks have default subnet masks as follows:

Class	1 <sup>st</sup> Octet High Order bits	1 <sup>st</sup> Octet Decimal Range	Default Subnet Mask
Class A	0	0-126*	255.0.0.0
Class B	10	128-191	255.255.0.0
Class C	110	192-223	255.255.255.0
Class D	1110	Reserved for Multicasting Experimental, used for research	
Class E	1111		

**Note.** \*Class A addresses 127.0.0.0 to 127.255.255.255 cannot be used because they are reserved for loopback and diagnostic functions.

### MULTIPLE CHOICE QUESTIONS

Q) Select the best answer of the following MCQs

- 1) In which communication mode data can be sent and received in both directions but not simultaneously?
  - A- Simplex mode
  - B- half-duplex mode
  - C- full-duplex mode
  - D- synchronous mode
- 2) Which of the following network devices connects a network to another network that uses different protocol?
  - A- Switch
  - B- Gateway
  - C- Router
  - D- Modem
- 3) Which of the following networks provide remote access and connect end users to their organization's network?
  - A- LAN
  - B- WAN
  - C- MAN
  - D- VPN
- 4) In which topology hub (switch) is used?
  - A- Star topology
  - B- Ring topology
  - C- Bus topology
  - D- Mesh topology
- 5) Which topology is most expensive to implement?
  - A- Star topology
  - B- Ring topology
  - C- Bus topology
  - D- Mesh topology
- 6) Which layer of OSI model decides which possible pathway the data should take to reach the destination?
  - A- Data link layer
  - B- Network layer
  - C- Transport layer
  - D- Session layer
- 7) Which network layer performs security, name resolution, logging and similar functions?
  - A- Transport layer
  - B- Network layer
  - C- Presentation layer
  - D- Session layer
- 8) Which of these cables transmit data using light waves?
  - A- Twisted pair cable
  - B- Coaxial Cable
  - C- Fiber optics cable
  - D- Telephone line
- 9) Which of these uses start stop bit for data transmission?
  - A- Asynchronous
  - B- Synchronous
  - C- Half-duplex
  - D- Full-duplex
- 10) Which bits are used at the start of a Class B IP address?
  - A- 0
  - B- 10
  - C- 101
  - D- 110

- 11) A set of computers connected together to share resources and information is called  
 A- Computer sharing                      B- Computer network  
 C- Computer interconnect                D- Computer linking
- 12) The set of rules to exchange data in communication network is called?  
 A- Protocol                      B- Procedure                      C- Forum                      D-Token
- 13) All of the following are elements of data communication system EXCEPT  
 A- Sender                      B- Transmission medium                      C- Receiver                      D-Voltage
- 14) Which of the following is a data transmission mode?  
 A- LAN                      B- Internet                      C- Full-duplex                      D-All
- 15) Which of the following is not a communication media?  
 A- Twisted pair                      B- Coaxial                      C- Microwave                      D-Modem
- 16) The medium in which signals are sent and received through a cable is called  
 A- Guided media                      B- Unguided media                      C- Local media                      D- none
- 17) Which of the following is an example of unguided media?  
 A- Twisted pair                      B- Coaxial                      C- Satellite                      D- Fiber Optics
- 18) Which of the following is ideal for long distance communication?  
 A- Communication satellite                      B- Twisted pair                      C- Coaxial                      D- Infrared
- 19) Terminators are used in \_\_\_\_\_ topology  
 A- Bus                      B- Ring                      C- Mesh                      D- Star
- 20) The default subnet mask of Class A is.  
 A- 255.255.0.0                      B- 255.0.0.0                      C- 255.255.255.0                      D- 255.255.255.255

### EXERCISE QUESTIONS

**Q2. Write short answers of the following questions**

- 1- Define computer network. *(Answer is on page 62)*
- 2- Define network communication & its basic components. *(Ans is on page 63)*
- 3- Briefly describe the modes of network communication? *(Ans is on page 63)*
- 4- Differentiate between asynchronous and synchronous network transmissions. *(Answer is on page 66)*
- 5- Differentiate between server and client computers. *(Answer is on page 62)*
- 6- Differentiate between LAN and WAN. *(Answer is on page 72)*
- 7- What is OSI model? *(Answer is on page 76)*
- 8- Compare TCP/IP Model with OSI model. *(Answer is on page 79)*

- 9- **Differentiate between circuit switched and packet switched networks.**  
 Ans. In circuit switching the data is transmitted by creating a dedicated path between two nodes. The entire circuit must be available to transfer data. Whereas in packet switching network the messages are divided into smaller pieces known as packets and sent through different routes.
- 10- **Briefly describe IP addressing.** *(Answer is on page 81)*

**Q3. Write long answers of the following questions**

- 1- **Explain different type of guided media.** *(Answer is on Page 66)*
- 2- **Explain microwave and satellite communications.** *(Answer is on Page 68)*
- 3- **Write notes on switch, router and gateway.** *(Answer is on Page 69-70)*
- 4- **Explain in detail Client/Server and Peer-to-Peer networks.**  
*(Answer is on Page 70)*
- 5- **Explain network topology and explain its types.** *(Answer is on Page 73)*
- 6- **Briefly describe the seven layers of OSI model.** *(Answer is on Page 76)*
- 7- **Briefly describe the four layers of TCP/IP model.** *(Answer is on Page 78)*

**Ans. Application Layer:**

The application layer is the top layer of TCP/IP. It is used to process the request. It ensures that a connection is made to an appropriate port. Here a port is a logical address that is used to direct data to the proper destination application.

**Transport Layer:**

The transport layer is related to the transmission of data. It is used to establish a network connection and manage the delivery of data between source and destination. The two main protocols used at this layer are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). TCP is more reliable protocol and it ensures the successful delivery of data whereas, UDP is faster but not very reliable and does not guarantee successful data delivery.

**Network Layer:**

The network layer is used for logical addressing, packaging and routing. It contains the data packet to be transmitted. The protocols used at this layer are Internet Protocol (IP) and Address Resolution Protocol (ARP) etc.

**Network Access Layer:**

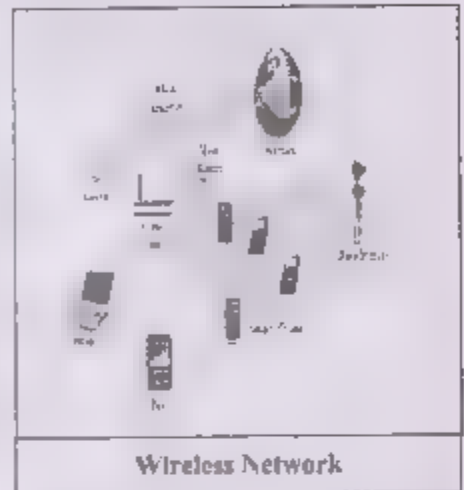
The network access layer is used for sending and receiving TCP/IP packets from through network medium. The protocols used at this layer are Ethernet and 802.11.

## UNIT 6

### WIRELESS COMMUNICATION

#### 6.1 WIRELESS COMMUNICATION

Wireless communication is a type of communication without any physical connection. It is used to transmit data over a short as well as long distance without any wires or cables. The use of wireless communication is becoming very popular and is replacing the conventional wired communication. Nowadays many devices such as smart phones, PDAs (Personal Digital Assistants), laptops, tabs and printers etc. have wireless communication features.



#### 6.1.1 WIRELESS COMMUNICATION NETWORK

A wireless communication network is a type of communication network that transmits data without using wires or cables. It transfers data through air using radio waves. Several devices can be used as network nodes, such as laptops and video cameras. Some commonly used wireless communication technologies are satellites, microwaves, Wi-Fi, WiMAX and infrared. These wireless communication networks can be used at homes, universities and industrial businesses. We can also find wireless networks in airports, hotels and libraries that usually provide internet access to users.

#### 6.1.2- ADVANTAGES AND DIS-ADVANTAGES OF WIRELESS COMMUNICATION NETWORK

##### Advantages of Wireless Communication Network

1. Wireless network allows the user to access the network from anywhere.
2. It allows adding new users easily without changing any physical connection.
3. Most wireless networks allow the users to connect automatically when they are in range.
4. Data of a wireless network can be filtered or simply blocked very easily.
5. It is less expensive to install because it does not require cables or wires.
6. It allows remote access to the computer and application to perform different tasks from anywhere.
7. The users can share files and other resources with other devices that are connected to the network without using wires.

### Disadvantages of Wireless Communication Network

- 1- Wireless network can be accessed by hackers more easily than wired network.
- 2- The speed of wireless network can be slower due to poor signals.
- 3- Some users may have coverage problem for low signal.
- 4- The strength of wireless signal becomes weaker as it travels through buildings.
- 5- Bad weather can weaken the signals.

## WIRELESS NETWORK TERMINOLOGIES

### 6.1.3- RADIO SIGNAL

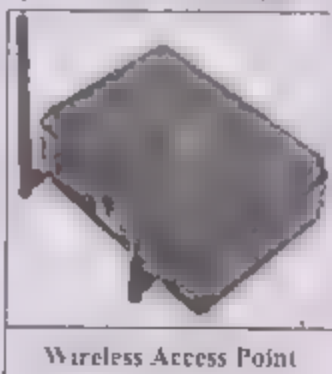
Radio signal is an electromagnetic wave that is propagated by antenna. It is also called radio wave. Radio signals have different frequencies. A specific radio signal can be picked by tuning the radio receiver to a specific frequency. A radio frequency system consists of two main components known as transmitter and receiver. The transmitter transmits the radio signals to the receiver and the receiver receives the signals. The Radio frequency system includes a set of rules that defines the communication between transmitter and the receiver.

### 6.1.4- RADIO TRANSCEIVER

Radio transceiver is a device that can send and receives radio signals. The transmitter and receiver are separated in traditional radio system. A radio set works as a receiver and the radio broadcasting station works as a transmitter. The transceiver can perform the functions of transmitter as well as receiver. A cell phone is an example of transceiver.

### 6.1.5- WIRELESS ACCESS POINT (WAP)

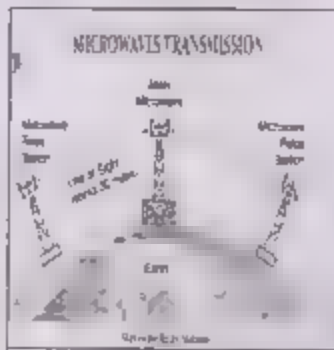
Wireless access point is a communication device similar to switch in a wired network. Wireless access point allows computer and other devices to transfer data wirelessly among them or to a wired network. It acts as a central device that transmits as well as receives radio signals. It has antenna that provide better signaling. Wireless access point support Wi-Fi and commonly used in public internet spots such as airports, hotels and libraries etc.



Wireless Access Point

### 6.1.6- LINE OF SIGHT COMMUNICATION

Line of sight is a type of communication in which the transmitter and receiver must be in line of sight means the transmitter and receiver must be in front of each other. This type of communication is used in high frequency communication where the signals cannot pass through buildings or hills. The transmitters are usually installed on



Line of Sight Communication



very high buildings, mountain tops or high towers.

### **6.1.7- SHORT AND LONG DISTANCE WIRELESS COMMUNICATION**

#### **6.2- SHORT DISTANCE WIRELESS COMMUNICATION**

Short distance wireless communication is a type of wireless communication that covers short distance of few meters (infra-red) to a distance up to 50 kilometers (Wi-MAX). Different types of short distance wireless communication are as follows.

##### **6.2.1-Wi-Fi**

Wi-Fi stands for Wireless Fidelity. It is a wireless communication system that uses radio waves to provide high speed internet and network connection. The information travels over the air. Wi-Fi is commonly used at homes and in offices. The range of Wi-Fi is limited. It typically covers a limited distance up to 300 feet. The signals become weaker as the distance increases. Wi-Fi is also known as Wireless LAN (WLAN). It must be secured with password in order to protect it from unauthorized users.

##### **6.2.2- WIMAX**

WiMAX stands for Worldwide Interoperability for Microwave Access. It is a type of wireless communication system that provides public network services to the users. It covers the distance from 40 km to 50 km. It is faster and provides greater range than Wi-Fi. It is commonly used to create Metropolitan Area Network that provides services just about anywhere you go in the city. It also provides an alternative to cable TV and DSL internet connection.

##### **6.2.3- BLUETOOTH**

Bluetooth is a type of wireless communication that allows the devices to communicate over a short distance up to 30 feet or around 10 meters. It uses radio waves to transfer data between two Bluetooth devices. It provides a data transfer speed from 700 kbps to 3 Mbps. Bluetooth doesn't require line of sight communication. Rather it uses radio waves that can pass through nearby walls and other barriers. The Bluetooth enabled devices include mobile phones, keyboards, digital cameras, laptops and printers etc. A desktop computer can use Bluetooth adaptor to connect with other Bluetooth devices.

##### **6.2.4- INFRARED**

Infrared uses infrared light waves to communicate over short distances. Infra-red waves are extremely high frequency waves which are used for short distance communication. It is sometimes referred to as line of sight communication because the light waves can only travel in a straight line. This requires that sending and

receiving devices must be in clear view of one another without any obstructions. Infrared is used in remote controls, infrared mouse, infrared keyboard etc

### **6.3- LONG DISTANCE WIRELESS COMMUNICATION**

Long distance wireless communication is a type of wireless communication that covers very long distance. Different types of long distance wireless communication are as follows.

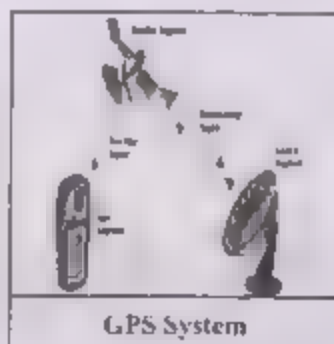
#### **6.3.1- CELLULAR COMMUNICATION**

Cellular communication is a wireless communication system that is widely used all over the world for mobile communication. It divides a physical region into different sections (areas) known as cells. Each cell has a base station (BS) that contains a transceiver and a controller. The cells are close enough to one another so that the signal strength is maintained throughout the area. Cells are linked together to enable a large number of cellular phones to communicate with one another.

In a cellular communication system each mobile uses a separate temporary frequency to talk to the base station. The base station can talk (connect) with many mobile users at a time. Paired frequency is used for communication. The uplink frequency is used by mobile phone to communicate with the base station and the downlink frequency is used by base station to communicate with mobile phones.

#### **6.3.2- GLOBAL POSITIONING SYSTEM (GPS)**

GPS is a navigational system that is used for finding the direction or reading map. It uses satellites and receivers to find the direction and determine exact location on earth. GPS system transmits data through radio signals to earth using satellite. The GPS receiver on earth receives these signals to calculate the exact location of the object. GPS can be used anytime on the land, in the sea or air. It can work in all types of weather.



##### **Application of GPS**

1. GPS is used for navigation i.e. it is used in vehicles to provide directions to the drivers.
2. It can also be used to find the stolen vehicle.
3. It can be used to find the location of a ship or submarine in the ocean.

#### **6.3.3- SATELLITE SYSTEMS**

A satellite is a relay station which is placed into orbit by human. It is used for various purposes such as military and civilian earth observation satellites, navigation satellites, weather satellites, and research satellites etc.

## CLASSIFICATION OF SATELLITE ORBITS / SYSTEMS

Satellite orbits can be classified into following three types

### 1- Geostationary Earth Orbit (GEO)

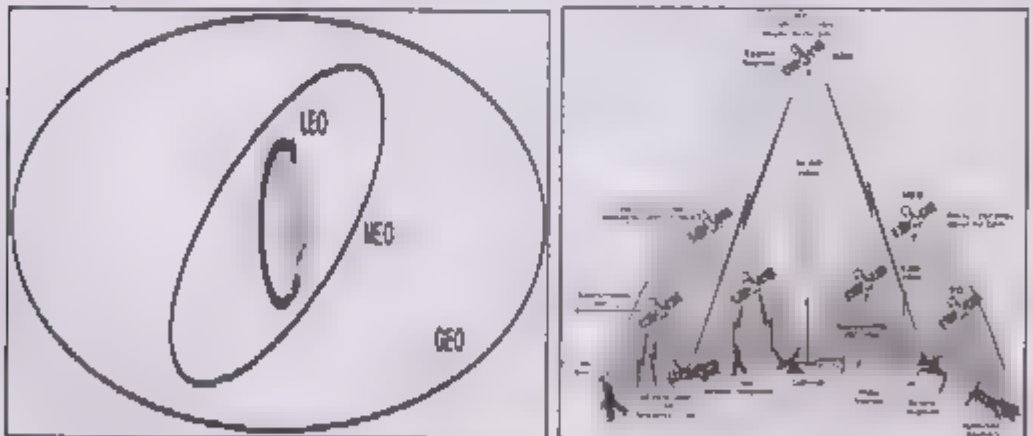
Geostationary earth orbit is an orbit that is located at altitude of about 35,786 kilometers directly above the equator of the earth. It enables the satellites to stay in one stationary position relative to earth. The communication satellites and weather satellites are generally placed in these orbits.

### 2- Medium Earth Orbit (MEO)

Medium earth orbit is an orbit that is located at altitude below 35,786 (GEO) and above 2,000 km (LEO). The most common use for satellites in this orbit is for navigation such as Global Positioning System that is placed in this orbit with an altitude of 20,200 km and GALILEO (a European Union satellite-based navigation system) is placed at about 23,222 kilometers from the earth.

### 3- Low Earth Orbit (LEO)

Low earth orbit is an orbit that is located at altitude of 160 km to 2,000 km above earth. The satellites placed in this orbit provide faster transmission than traditional satellites. It is less expensive and requires less power to launch satellites in this orbit. Most of the satellites, like the International Space Station, the space shuttle, and the Hubble Space Telescope are all exist in Low Earth Orbit.



## 6.4- MOBILE COMMUNICATION

Mobile communication is a type of communication that involves mobile devices such as smart phones, laptops, PDAs and tablets etc. The mobile communication devices allow the users to communicate and access information from anywhere.

### 6.4.1- REQUIREMENTS OF MOBILE COMMUNICATION

The following are the components required for mobile communication.

1- Mobile phone

2- Base Station

3- Switching node

4- land line telephone network

**1- Mobile phone**

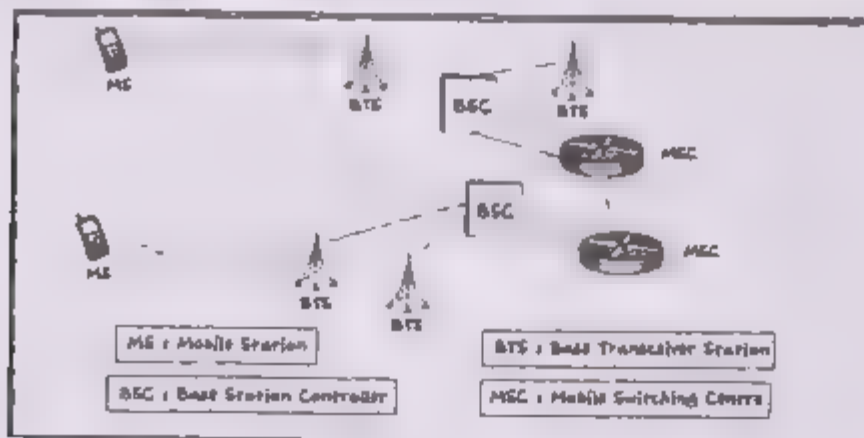
Mobile phone is a device that is used to make and receive phone calls over cellular network. The modern mobile phones have many features such as text messaging, MMS (Multimedia Messaging Service), email and internet. In mobile communication the mobile phones are also known as mobile stations.

**2- Base Station**

Base station is used to manage all communication system between mobile phones and handles the signaling and mobile traffic. It contains a transceiver and antenna to transmit and receive signals from mobile phones. Base station is also known as base transceiver station.

**3- Switching Node**

Switching node is a mobile telecommunication switching office that is an important component of cellular network. It is used to perform user authentication, traffic control, roaming, billing, network support and maintenance etc. Each base station is connected to switching node i.e. mobile telecommunication switching office. One switching node may serve many base stations.



Mobile Communication System

**4- Telephone Landline Network**

Telephone landline network is a wired Public Switched Telephone Network (PSTN). It is the worldwide telephone network for data and voice communication. It is connected with MTSO (Mobile Telecommunication Switching Office) in the cellular network. It provides communication between mobile phone and landline.

### 6.4.2- ARCHITECTURES FOR COMMUNICATION OVER MOBILE DEVICES

Different architectures for communication over mobile devices are as follows

#### 1- Web Protocol Stack (HTTP / TCP/IP)

Web protocol consists of TCP IP and HTTP protocols. It allows two computers to communicate with each other over the internet. Every computer requires web protocol stack to communicate over the internet. It is generally built in the operating systems.

When a message is sent over internet, it is converted from text form to electronic signals at the source end and converted back to text form at the destination end.

#### 2- Wireless Markup Language (WML)

Wireless markup language is based on Hypertext Markup Language (HTML) and Extensible Markup Language (XML). It is used to publish internet contents for wireless devices such as mobile phones. These devices have small display, slow processing and less memory etc. that is why WML is used in mobile devices because XML supports small display, less memory and processing power than HTML.

#### 3- Wireless Application Protocol (WAP)

Wireless application protocol (WAP) provides internet access to wireless devices such as smart phones and tablets etc. It is used as a standard for providing data and voice services to mobile devices.

### 6.4.3- FEATURES AND LIMITATIONS OF MOBILE COMMUNICATION SYSTEM

#### Features / Advantages of Mobile Communication System

1. Mobile communication system allows user to communicate from anywhere.
2. The businessman can use it during travelling to manage and monitor business activities.
3. The users can share files and other resources with other devices that are connected to the network without using wires.

#### Limitations / Disadvantages of Mobile Communication System

- 1- It requires proper protection from hackers, who may install spyware on mobile devices. This may capture credit card information, login detail and password that can be very harmful for your personal data.
- 2- The wireless mobiles have slow speed, low memory and limited processing power as compared to full featured computer.



3. Handheld mobile devices have the limitations of small displays
4. The validity and accuracy of information cannot be guaranteed since anybody can easily upload any information on web sites.
5. Daily use of mobile computing devices is making people more dependent on these devices instead of relying on their own potentials

### MULTIPLE CHOICE QUESTIONS

Q) Select the best answer of the following MCQs

- 1) Which of the following has a range of 40 to 50 km?  
A- Wi-Fi      B- Wi-MAX      C- Bluetooth      D- Infrared
- 2) Which of these uses extremely high frequency waves for short range communication?  
A- Wi-Fi      B- Wi-MAX      C- Bluetooth      D- Infrared
- 3) Which of these is used for communication between mobile phones, laptop computers and digital cameras?  
A- Wi-Fi      B- Wi-MAX      C- Bluetooth      D- Radio signals
- 4) Which of these is positioned 11 from 160 to 2000 km above the earth's surface?  
A- Geostationary Earth orbit      B- Medium Earth Orbit  
C- Low Earth Orbit      D- GALILEO
- 5) Which orbit is located directly above the earth's equator?  
A- Geostationary Earth orbit      B- Medium Earth Orbit  
C- Low Earth Orbit      D- GALILEO
- 6) What is fixed station in a cellular wireless network called that provides local coverage for mobile communication?  
A- Base Station      B- Satellite      C- Mobile terminal      D- GPS
- 7) What is used to create web pages?  
A- HTML      B- HTTP      C- WAP      D- TCP
- 8) What is HTTP?  
A- Markup language      B- Protocol for mobile devices  
C- Application layer protocol      D- Transport layer protocol
- 9) Which of these provides wireless alternative to cable TV and DSL?  
A- Bluetooth      B- Infrared      C- Wi-Max      D- Wireless Access Port
- 10) In which earth orbit satellite is placed for navigation?  
A- Geostationary Earth orbit      B- Medium Earth Orbit  
C- Low Earth Orbit      D- High Earth Orbit
- 11) What is propagated through air and received by an antenna to transmit data signals?  
A- Radio waves      B- Sound waves      C- Gamma Rays      D- Magnetism
- 12) Microwave uses \_\_\_\_\_ propagation?  
A- Ground      B- Space      C- Line-of-sight      D- Sky
- 13) Which device allows wireless devices to connect to a wired network using Wi-Fi?  
A- Access Point      B- Antenna      C- Repeater      D- NIC
- 14) Which of the following is a short range wireless technology?  
A- Bluetooth      B- Satellite      C- Cellular      D- GPS
- 15) Bluetooth technology is commonly used in:  
A- Mobile phones      B- Scanner      C- Satellite      D- Server

- 16) GPS satellites are \_\_\_\_\_ satellites.  
 A- GEO B- MEO C- LEO D- REO
- 17) Cellular phones work by using \_\_\_\_\_ to communicate.  
 A- Radio waves B- Infrared C- Fiber optics D- Micro browsers
- 18) Cellular radio systems divide the service area into many smaller areas known as \_\_\_\_\_.  
 A- Pods B- Cell C- Cubes D- Sector
- 19) WAP stands for \_\_\_\_\_.  
 A- Wireless Application Protocol B- Wired Application Protocol  
 C- Wide Application Protocol D- Wide Area Protocol
- 20) Which of the following is ideal for long distance communication?  
 A- Satellite communication B- Infrared C- Bluetooth D- WiMAX

**Q.No. 1.(b) Write TRUE or FALSE.**

Statement	TRUE or FALSE
1. Radio signal is also called radio wave.	
2. Wi-Fi is a short distance wireless communication.	
3. GPS is a cellular communication system.	
4. Radio transceiver converts the radio signals.	
5. CD, MFO and LEO are the satellite systems.	

**EXERCISE QUESTIONS**

**Q2. Write short answers of the following questions**

- 1- Define radio signal and transceiver. *(Ans is on page 87)*
- 2- What is Wireless Access Point? *(Ans is on page 87)*
- 3- What is meant by line of sight communication? *(Ans is on page 87)*
- 4- Differentiate between short distance and long distance wireless communication.  
 Ans. Short Distance Wireless Communication covers distance of few kilometers up to 50 kilometers. The examples of short distance communication are Wi-Fi, Wi-Max, Bluetooth and Infrared etc. The Long Distance Wireless Communication covers very long distance over 50 kilometers. The examples of long distance wireless communication are cellular Communications and Global Positioning system.
- 5- What is base station? *(Answer is on page 91)*
- 6- Define Global Positioning System(GPS). *(Answer is on page 89)*
- 7- What is Wireless Markup language? *(Answer is on page 92)*
- 8- What is Wireless Application Protocol? *(Answer is on page 92)*

**10- What is HTTP?**

**Ans** HTTP stands for Hyper Text Transfer Protocol. It is a communication protocol used to connect to servers on World Wide Web. It is used to establish connection with a web server and transmit HTML pages to user's browser. It also allows users to access the internet.

**Q3. Write long answers of the following questions**

- 1- Define wireless communication and mention its advantages and disadvantages. *(Answer is on Page 86-87)*
- 2- Describe the following short distance communication. *(Ans is on Page 88)*  
\* Wi-Fi      \* Wi-Max      \* Bluetooth      \* Infra-red
- 3- Describe cellular communication and mention its advantages and disadvantages. *(Answer is on Page 89)*
- 4- Describe GEO, MEO, and LEO. *(Answer is on Page 90)*
- 5- Explain how mobile communication is achieved? *(Answer is on Page 90-91)*
- 6- What are the limitations of mobile communication? *(Answer is on Page 20)*

## UNIT 7

### DATABASE FUNDAMENTALS

#### 7.1- INTRODUCTION TO DATABASE

Databases are used almost everywhere including banks, retail, websites and warehouses. Banks use databases to keep track of customer accounts, balances and deposits. Retail stores can use databases to store prices, customer information, sales information and quantity on hand.

#### **7.1.1- DATA AND INFORMATION**

##### **Data**

Collection of raw facts and figures is said to be a data. The word "raw" means unprocessed or unorganized. The data is given to the computer as input. It can be processed to produce useful information. For example the data of a student may consist of roll no, name, father name, marks of different subjects. The purpose of collecting this data is to maintain the record of the students. Data may consist of text, numbers, images, audio and video.

##### **Information**

The processed form of data is called information. The information is meaningful, useful and organized form. The computer processes data to convert it into information. It is the output of the processing. For example the data of the students can be processed to produce useful information such as total marks and grade of the student. It can also be processed to find the number of passed and failed students etc.

#### **Difference between Data and Information**

	<b>DATA</b>	<b>INFORMATION</b>
1)	Data is a collection of raw facts and figures.	Information is processed form of data
2)	It is used as input in the computer	It is the output of the computer
3)	It is normally huge in its volume	It is normally short in its volume.

#### **7.1.2- CONVENTIONAL FILE MANAGEMENT SYSTEM**

In Conventional File Management System the data is kept using computer files. Data is stored and managed in data files through application programs. Each department (section) of an organization defines and uses its own data files needed for different tasks. The traditional file processing system leads to the following problems

### 1- Data Redundancy

Data redundancy means unnecessary duplication of data in different files. For example in university environment, admission office creates a named 'student.dat', this file contains the information of students such as roll no, student name, father name, address, date of birth etc. Similarly examination office creates a file named 'result.dat', which contains information of student such as roll no, student name, father name, address, date of birth. It also contains marks of physics, marks of computer, marks of math and marks obtained. In this case both files contain roll no, student name, father name, address, date of birth. It means same data of student is stored in multiple files. This is known as redundancy.

### 2- Data Inconsistency

In traditional file processing, data is isolated in separate files. Same information of a particular object may be stored in different files. For example if the address of a particular student is changed and updated in the file named 'student.dat' of admission office but due to some reasons it is unchanged in the file named 'result.dat' of examination office and showing the old address of a student. Then this leads to the problem of inconsistency because same data reflects different information in different files.

### 3- Lack of Flexibility

In such systems when information of a non-routine nature is needed for example from 'student.dat' name of student, address and date of birth is required and from 'result.dat' marks of physics and marks of computer is required then we have to spend a lot of time to assemble (collect) the data from various files.

### 4- Limited Data Sharing

If one department of an organization contains the data which is required by other department, it is very difficult to obtain it because of limited data sharing.

## 7.1.3- DATABASE APPROACH

In order to solve the problems of traditional file management system, the concept of database was introduced. The database is an organized collection of related data about particular object/entity that is useful for the organization for which the database is developed.

The database can be of any size and complexity. For example we can make a database of names and telephone numbers of our friends which may have very few records. Similarly it can be a huge database containing information about all citizens of a country for national identity card which may have millions of records.

A database may be manual or computerized. The library card catalogue is an example of manually created and maintained database. On the other hand library management



system, stock control system and examination system are examples of computerized databases. The computerized databases are created and maintained by using database management system.

#### 7.1.4- DBMS

DBMS stands for Data Base Management System. It is a software or collection of programs used to manage the database. It allows user to create, maintain and manipulate database and store or retrieve the data from database files. The overall purpose of DBMS is to improve data sharing, data access, decision making and increase end user productivity. Manipulation of data using DBMS includes the following:

- Adding new data to the database.
- Deleting existing data from the database.
- Updating the existing data.

Database management system provides an environment in which the user can access the data easily. It also provides user-friendly access and controls between the user and the database. Some examples of database systems managed by DBMS are as follows:

- Customer information system
- Inventory system
- Library Management system
- Accounting and bookkeeping

MS-Access, Oracle, SQL, and Sybase are some of the examples of DBMS.

#### 7.1.5- ADVANTAGES OF DATABASE SYSTEM/DBMS OVER FILE MANAGEMENT SYSTEM

Following are some of the advantages of database system/DBMS:

##### 1- Reduced Data Redundancy

In database system/DBMS, all the data of an organization is integrated into a single database. The data is stored at only one place in the database and is not duplicated in several files. As the data is integrated into a single database so that multiple copies of the same data are reduced to single copy. In database system/DBMS, the data redundancy can be controlled and minimized but it cannot be removed completely.

##### 2- Data Consistency

By controlling the data redundancy the data consistency is obtained. If a data item appears only once, any update to its value has to be performed only once and the updated value is immediately available to all the users of all departments, then the data remains consistent.

### 3- Flexibility

The database management system is very flexible than the traditional file management system. It stores data in a central place that allows the user to produce the desired information in different ways which could not be done in traditional file management system.

### 4- Data Sharing

In database system DBMS data can be shared by authorized users of the organization. The DBA (Data Base Administrator) manages the data and give rights to users to access the data over a network. Many users can be authorized to access the same set of information simultaneously.

### 5- Data Security

Data security is the protection of database from unauthorized users. Only the authorized persons are allowed to access the database. Most of the database systems DBMS provide the security sub system which the DBA uses to create account of users and to specify account restrictions. The users enter their user name and password to access the data from database.

### 1.6- DATABASE ADMINISTRATOR (DBA)

A person, who is responsible for managing and supervising overall database management system and its use is called Database Administrator (DBA).

### ROLE / RESPONSIBILITIES OF DATABASE ADMINISTRATOR

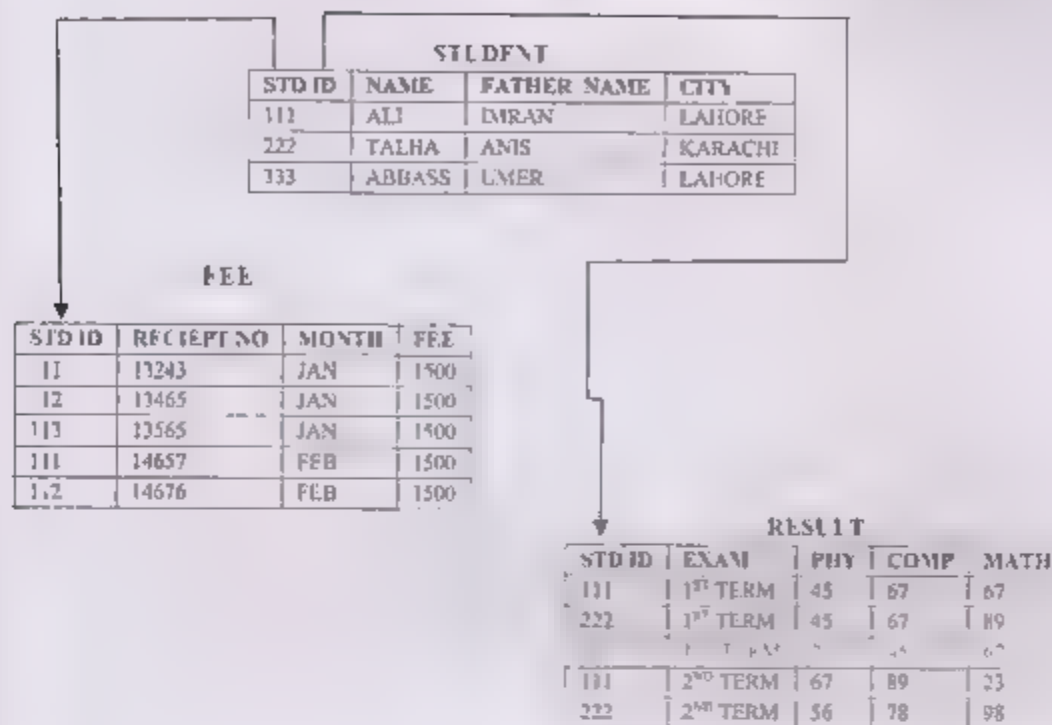
The DBA has the following responsibilities:

- 1- Designing the data base.
- 2- Planning security measures.
- 3- Monitoring the database system.
- 4- Creating users and assigning passwords to them.
- 5- Taking regular backups of database.
- 6- Restoring the system in case of any problem or system crash.
- 7- Providing training to the new users.

### 1.7- DATABASE MODELS

Database model is the logical structure of a database that determines how the data can be stored, organized and manipulated. Different types of database models are as follows:

- 1- Hierarchical Database Model
- 2- Network Database Model
- 3- Relational Database Model
- 4- Object-Oriented Database Model
- 5- Object Relational Database model



### Relational Database Model

#### 4- Object-Oriented Database Model

Object oriented database model is a type of database model that represents the information in form of objects as used in Object Oriented Programming Language such as C++ and Java. Real world objects have two main characteristics that is state (properties) and behavior (functions). For example CAR is any object. It has different states (properties) like price, color, model etc. Similarly it has different behaviors (functions) such as start, stop, turn and reverse etc.

#### 5- Object Relational Database Model

Object relational database model is a type of database model that is very similar to relational model. It uses object-oriented approach. The data is stored in database as objects and can be manipulated using query language. Oracle is the leading object relational database management system.

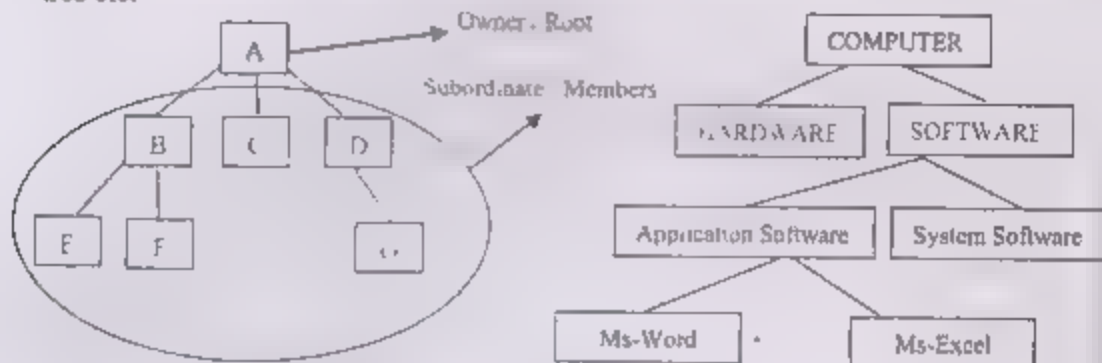
### 7.1.8- DATABASE LANGUAGES

Database language is used to perform different operations on the database. SQL (Structured Query Language) is a standard language for accessing and manipulating the database. There are three types of SQL languages for relational databases. These are

- 1- Data Definition Language
- 2- Data Manipulation Language
- 3- Data Control Language

### 1- Hierarchical Database Model

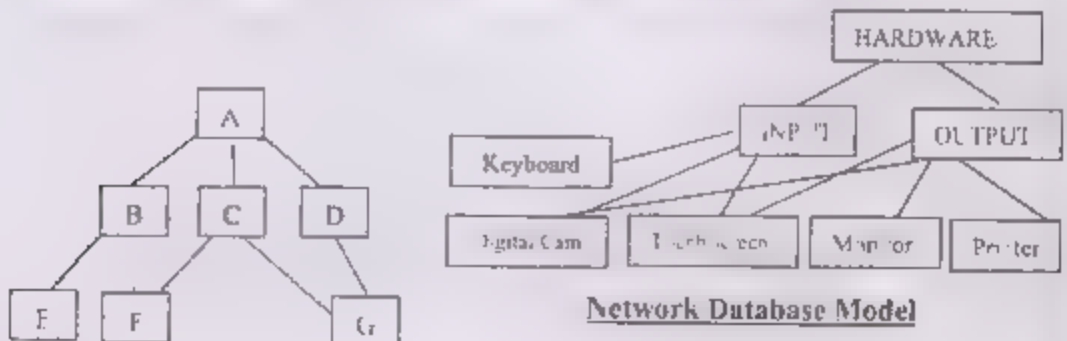
Hierarchical Database Model is a database model that organizes data in a tree-like form. It represents data elements with owner and subordinate relationship. The data elements in a subordinate are called members. The data elements that have subordinate are called owners. Subordinates can have only a single owner. The data element at the top most level is called root has no owner. Some examples of hierarchical database model are table of contents, organizational chart, and family tree etc.



Hierarchical Database Model

### 2- Network Database Model

Network Database Model is a database model in which some data elements can have more than one owner. It is more complex than hierarchical model.



Network Database Model

### 3- Relational Database Model

Relational Database Model is a type of database model that organizes and stores data in relations. A relation is a term used for a table. A table consists of rows and columns. One row of a table represents one record. Each column of a table represents a field or attribute. The tables are linked with each other by common fields. The relational model provides more flexibility than hierarchical and network database and is the most commonly used database model.

### 1- Data Definition Language

Data Definition Language (DDL) is used for defining the structure of database. DDL statements are used to create, modify and remove data objects such as tables. Some important tasks of DDL are

- To create objects in a database such as tables
- To alter (modify) the structure of the database
- To delete objects from the database

### 2- Data Manipulation Language

Data Manipulation Language (DML) statements are used to manage or manipulate data in the database. Some important tasks of DML are

- To insert data into a database table
- To retrieve data from a database
- To update existing data within a table
- To delete records from a table

### 3- Data Control Language

Data Control Language (DCL) is used for controlling the data access to the database. A user can access the data based on the privileges given to him. Some important tasks of DCL are:

- To allow specified users to perform specific tasks
- To disallow specified users from performing specified tasks
- To cancel previously granted or denied permissions

## 7.2- BASIC DATABASE TERMINOLOGIES

Following are some important terms used in database.

### 1- Table/Relation

A database table is a file that contains data about a single entity. An entity can be a person, place or event etc. For example, 'Student', 'Teacher' and 'Stock' are entities. A database table consists of rows and columns. Rows hold the records and columns hold the fields. The data items are inserted in each row and column intersection called cell. Tables are also called relations in RDBMS.

STUDENT

STD ID	NAME	FATHER NAME	CITY
111	ALI	EMRAN	LAHORE
222	TALHA	ANIS	KARACHI
333	ABBAS	UMER	LAHORE

### 2- Records / Tuple / Row

A collection of related fields treated as a single unit is called a record. All the information about one person or item is held in a record. When records are stored in



a table, rows represent records and columns represent fields. In relational database rows are also known as tuples. The above database table has 3 records w

### 3- Entity

Anything in the real world that has a set of different attributes or properties is known as entity. An entity may be an object with a physical existence such as 'person', 'place', 'vehicle', 'computer', 'student', and 'teacher' etc. Similarly an entity may be an object with a conceptual existence such as 'university course', 'job', and 'account' etc.

### 4- Fields / Attribute / Column

An attribute is a characteristic of an entity. Field or attribute is a part of a record that contains a single piece of data about an entity. The fields or attributes appears as columns in a table.

### 5- File

A file is a collection of all the related records. For example a stock file contains records for stock items, payroll file contains records for employees and so on. In a relational database records are stored in files called tables, relations.

### 6- View

A view is a virtual table that consists of rows and columns. It may display selected data from several tables simultaneously. View cannot exist independently of tables.

### 7- Data Types

Data type indicates the type of data that can be stored in the field of a table. Data types available in a relational database are character data, integers, real numbers, Boolean data, date/time, etc.

- **Character**: It is used to store text and combinations of text and numbers.
- **Number**: It is used to store whole numbers (Integer or real).
- **Boolean data**: It is used for True or False values. Null values are not allowed.
- **Date and time**: It is used for storing date and time.

### KEY

It is an attribute (or field) that is used to identify records in a table. Following are the most common keys that are used in DBMS, RDBMS.

### 1- Primary Key

Primary key is a key field that uniquely identifies a record. It cannot be NULL and it cannot be repeated as well.

An attribute of the entity is selected as primary key if its value for each record is unique. For example, in the EMPLOYEE entity of an organization that has attributes 'EmpCode', 'EmpName', 'EmpSalary', and 'EmpDOB' etc. Each employee has a unique code assigned by the organization. The most suitable attribute of the EMPLOYEE entity for selecting primary key is 'EmpCode' because it uniquely identifies each employee in the organization. On the other hand, the attribute like 'EmpName' is not unique, because more than one employee may have same names. So it cannot be used as primary key.

### 2- Candidate Key / Alternate Key

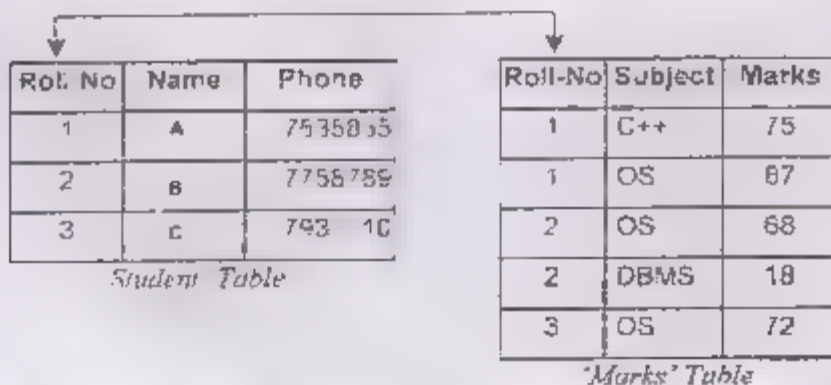
An entity may have more than one key fields that can be used as primary key but not chosen as primary key is known as candidate keys or alternate keys. For example, STUDENT table may have fields 'Name', 'Roll No', 'CNIC', 'Registration No', and 'Address' etc. In STUDENT table, 'Roll No', 'CNIC' and 'Registration No' are key fields that act as primary key. If 'roll no' is chosen as primary key then 'CNIC' and 'registration no' can be called as candidate keys.

### 3- Secondary Key

Keys other than primary key in the table are known as secondary key. Sometimes a record in a table need to be searched on field other than primary key such a field is known as secondary key.

### 4- Foreign Key

A foreign key is an attribute in a table whose values must match with a primary key in another table when a relationship is made between two or more than two tables. The table that contains the foreign key is called secondary table. Similarly, the table to which the foreign key refers to is called the parent table.



### **7.3- DATABASE PLANNING**

Database planning is a systematic approach to the development of database. It involves designing, development and implementation of a database. A well-designed database allows users to use the database in an efficient manner. Database should be well planned to save time, efforts, and make it perform the expected tasks.

#### **STEPS IN DESIGNING THE DATABASE**

The following steps are involved in planning a database.

##### **1- Problem Identification / Definition**

The problem identification step is used to identify the nature and scope of the problem, to be solved. The problem is clearly defined. The database developer also determines the available and un-available information. The problem is analyzed in order to gather as much information as possible for finding a solution. For example, there are some problems to manage the library of a college. It is difficult for the reader to find the required book. The situation will lead to initial investigation to identify the exact problem. The next steps will be performed if the investigation identifies the problem and suggests a new system.

##### **2- Feasibility Study**

The feasibility study is used to find one or more solutions of the problem. It also suggests the most desirable and economical solution. For this purpose the database developer needs to generate several solutions of the problem to select the best solution among them. Feasibility study includes the following tasks:

- Investigate the problem.
- Find out all the possible solutions available
- Study all the solutions to determine their feasibility
- List the issues with each solution
- Select the best solution for implementation.
- Prepare the results in a feasibility report.

##### **3- Requirement Analysis**

The requirement analysis is used to understand the problem in detail. It determines all the requirements expected from the proposed solution. It is important to create a complete and accurate representation of all the requirements and to create solution that satisfies all the requirements.

For example, to develop 'Student Management System' a detailed study is needed to analyze the requirements. This will include the following:

- Entities such as Student and Result etc
- Number of tables required to store the data.
- Fields require in each table for different entities.

- Key field in each table.
- Data types for the fields.
- Relationship between entities.
- Forms design for input.
- Queries to gather selected information
- Reports for printing information.

#### 4- Identify Entities and Attributes

After requirements identification, this step is used to identify the entities and its attributes. An entity may be an object with a physical existence such as person, place, vehicle, computer, student, teacher etc. Similarly, an entity may be an object with a conceptual existence such as 'university course', 'job', 'an account' etc.

An Attribute is a property that describes an entity. For example if employee is an entity then, the employee's name, age, address, salary and job etc. are the attributes.

For example, to develop 'Student Management System' the following entities and attributes will be required.

Entities	Attributes
STUDENT	RollNo, Name, Address, Phone
RESULT	ResultID, Exam, Marks
FEE	ReceiptNo, Std Name, Month, FeeAmount

#### 5- Assigning Names to Tables and Columns

In this step the entities are converted into tables and attributes into Columns of the tables. The names should be logical and meaningful throughout the database. For example "Student" for Student's table. In Case of attributes, meaningful names should be used wherever possible and the columns for table may be RollNo, name, Address, Phone.

### 7.4- DATA MODELING AND ENTITY RELATIONSHIP DIAGRAM

#### 7.4.1- Data Modeling

Data modeling is a process of designing the logical structure of a database using diagram with text and symbols that represent the flow of data and the relationship between objects. Data models are created during the analysis and design phases of a project. A good data model helps the user to identify the errors and make changes before writing programming code.

Data model designers often use multiple models to view the same data and ensure that all processes, entities relationships and data flows have been properly identified.

#### TYPES OF DATA MODELING

- **Conceptual Data Modeling**

The conceptual data modeling is used to identify the entities and highest-level relationships between different entities. It does not specify any attributes of primary keys.

- **Enterprise Data Modeling**

Enterprise data modeling is used to identify the scope and requirements for specific business organization. It analyzes current data processing and general business functions.

- **Logical Data Modeling**

The logical data modeling is used to identify the specific entities and relationships between them in detailed level. It specifies all attributes and the primary key for each entity.

- **Physical Data Modelling**

The physical data modeling represents the implementation of the logical data model that is specific to the application and database. It shows how the logical data model will be created in the database. It specifies all table structures including column name, data type, primary key, foreign key and relationships between tables.

## **ELEMENTS OF DATA MODELING**

### **1- Entity**

Anything in the real world that has a set of different attributes or properties is known as entity. It is the important thing about which data is stored in the database. An entity may be an object with a physical existence such as person, place, vehicle, computer, student, teacher etc. Similarly, an entity may be an object with a conceptual existence such as 'university course', 'job', 'an account' etc.

### **2- Attribute**

The characteristics or properties of an entity are called attributes. An entity may have many attributes. The attributes are used to define the entity. For example, an entity 'CAR' can have many attributes like price, color, model etc.

### **3- Relationship**

A relationship is a link or association between two entities. It indicates how the entities are connected or related to each other. An example of relationship is between mother and children. A mother may have many children, but each child has only one mother.

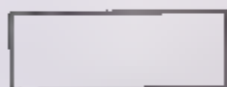


#### 4- Keys

A key is an attribute that uniquely identifies the record in the database. The keys are used to create relationships between different entities. They are also used to ensure the data is not duplicated.

#### 7.4.2- ER. DIAGRAM / MODEL

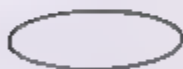
The Entity Relationship Diagram/Model is used to construct the conceptual structure of database. It is commonly used during the initial phases of database development process, to create data model that can be used to implement the database. Entity Relationship diagram/model is a diagrammatic (pictorial) way of representing attributes, entities and relationship between entities. Different symbols are used in E R diagram which are as follows:



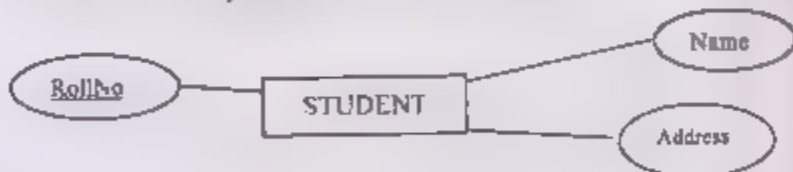
A rectangular box is used to represent entity. An entity is anything in real that has some characteristics such as STUDENT, TEACHER etc.

STUDENT

TEACHER



Ellipse (oval) shape is used to represent an attribute. An attribute is the characteristics of an entity. Every attribute is defined by its set of values called domain. For example in a school database a 'STUDENT' is considered as entity. It has various attributes like RollNo, name, dob, class etc. The key attribute is always underlined like RollNo.



A relationship between entities is indicated by diamond shape. For example a relationship between STUDENT and TEACHER.



## RELATIONSHIP

A relationship is a link or logical association among entities. For example, an association (relationship) between mother and children. A mother may have many children, but each child has only one mother.

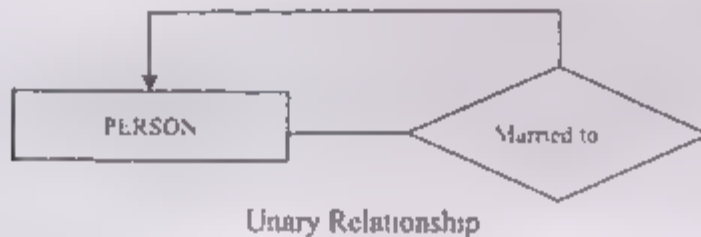
## DEGREE OF RELATIONSHIP

The number of entities participating in a relationship is known as degree of relationship. Degree of relationship is of two types as follows.

### 1- Unary Relationship

A type of relationship in which only one entity type participates in a relationship is called unary relationship. The unary relationship is also known as recursive relationship.

Example:



### 2- Binary Relationship

A type of relationship that involves two entity types is called binary relationship.

Example:



## TYPES OF BINARY RELATIONSHIP

There are three main types of binary relationship between two entities as follows:

- 1- One-to-Many
- 2- Many-to-Many
- 3 One-to-One

### 1- One-to-Many Relationship

A one-to-many relationship is the most common type of relationship. In this type of relationship, two entity types are associated in such a way that for one instance of First entity type, there can be many matching instances in Second entity type. On the other hand, for each instance in Second entity type, there is only one matching instance in First entity type. For example, the Employees and Department tables have a one-to-many relationship i.e. each Department has many employees, but each employee has related to one department. The one-to-many relationship is indicated with 1 N.



## 2- Many-to-Many Relationship

In a many-to-many relationship two entity types are associated in such a way that for each instance in First entity type, there can be many matching instances in Second entity type. On the other hand, for each instance in Second entity type, there can also be many matching instances in First entity type. For example, the Patient and the Doctor have a many to-many relationship because a patient may be checked by many doctors. On the other hand, a doctor may check many patients.



## 3- One-to-One Relationship

In a one-to-one relationship, two entity types are associated in such a way that for each instance in First entity type, there is only one matching instance in Second entity type. On the other hand, for each instance in Second entity type, there must only one matching instance in First entity type. For example, the Country and President have a one-to-one relationship. Each Country has only one president and vice versa.



## 7.4.3- CARDINALITY AND MODALITY

Cardinality and Modality are used to indicate the number of maximum and minimum instances that can take part in the relationship. Both are shown at both ends of the relationship in ER diagram.

### Cardinality

The maximum number of instances of one entity associated with each instance of the related entity is known as cardinality. The cardinality can be one or many.

**One** The cardinality of one indicates single instance of an entity. The symbol of a vertical line is used for one cardinality.

**Many** The cardinality of many indicates multiple instances of an entity. The symbol of crow's foot is used for many cardinality.

The symbols of cardinality are placed on the outside ends of the relationship line, closest to the entity name in the ERD diagram.

### Modality

The minimum number of instances of one entity associated with each instance of the related entity is known as modality. The modality can be 0 or 1.

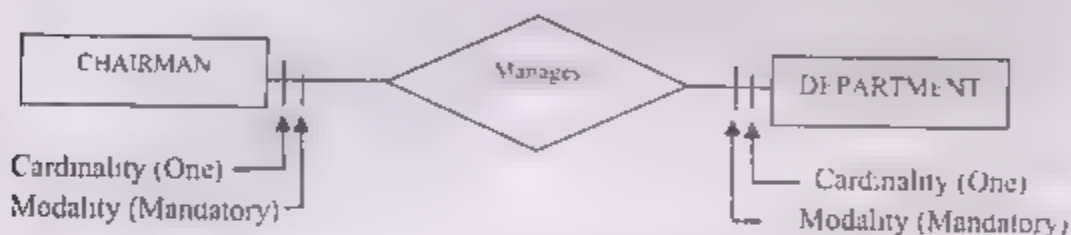
- Zero (optional):** The relationship is called optional when the minimum number is zero. The small circle O is used to indicate zero modality.
- One (Mandatory):** The relationship is called mandatory when the minimum number is one. The vertical line is used to indicate one modality.

The symbols of modality is placed in the inside ends of the relationship line next to the cardinality symbol.

#### 7.4.4- EXAMPLES OF CARDINALITY AND MODALITY IN A RELATIONSHIP

##### One-to-One Relationship:

###### Example 1:

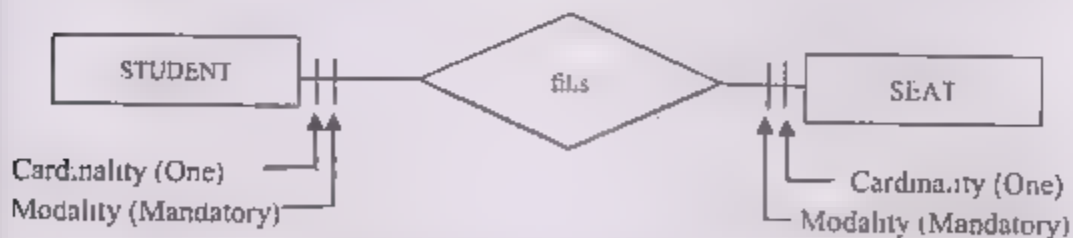


**Cardinality:** One CHAIRMAN can manage a maximum of one DEPARTMENT. One DEPARTMENT can be managed by a maximum of one chairman. Each side of the relationship has the cardinality of 1.

**Modality:** One chairman must manage at least one Department. One Department must be managed by at least one Chairman. Each side of the relationship has the modality of 1 or mandatory.

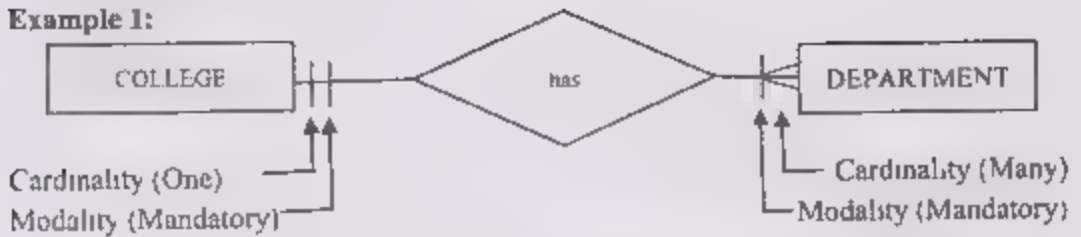
##### One-to-One Relationship:

###### Example 2:



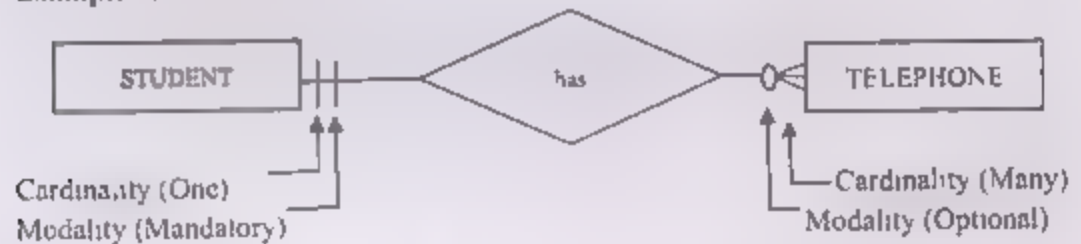
**Cardinality:** One STUDENT can fill a maximum of one SEAT. One SEAT can be filled a maximum of one STUDENT. Each side of the relationship has the cardinality of 1.

**Modality:** A STUDENT must fill at least one SEAT. One SEAT must be filled by at least one STUDENT. Each side of the relationship has the modality of 1 or mandatory.

**One-to-Many Relationship:****Example 1:**

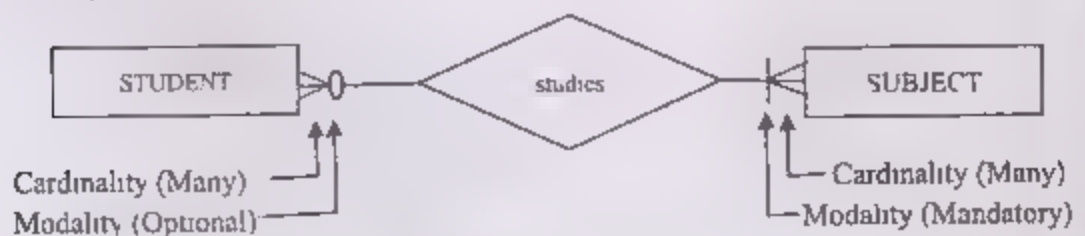
**Cardinality:** One COLLEGE can have many DEPARTMENTS. One DEPARTMENT can belong to maximum one COLLEGE. The cardinality of relationship is 1 to many.

**Modality:** One COLLEGE must have at least one DEPARTMENT. One DEPARTMENT must belong to at least one COLLEGE. Each side of the relationship has the modality of 1 or mandatory.

**One-to-Many Relationship:****Example 2:**

**Cardinality:** One STUDENT can have many TELEPHONES. One TELEPHONE belongs to only one STUDENT. The cardinality is one-to-many from STUDENT to TELEPHONE side.

**Modality:** One STUDENT may not have any TELEPHONE. One TELEPHONE must belong to at least one STUDENT. The modality is optional from STUDENT to TELEPHONE and Mandatory from TELEPHONE to STUDENT side.

**Many-to-Many Relationship:****Example 1:**

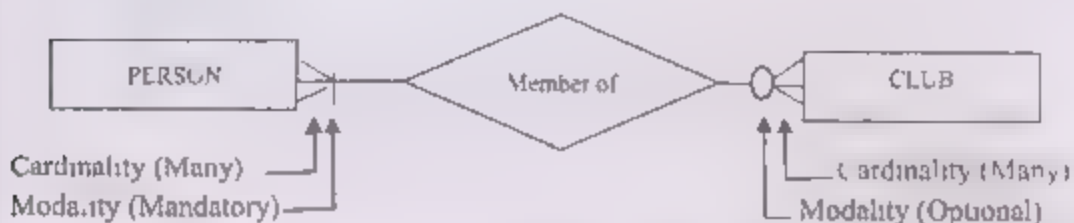
**Cardinality:** One STUDENT can study many SUBJECTS. One SUBJECT can be



**Modality** One STUDENT must study at least one SUBJECT. One SUBJECT may not be studied by any student. The modality is mandatory from STUDENT to SUBJECT and optional from SUBJECT to STUDENT.

### Many-to-Many Relationship

**Example 2:**

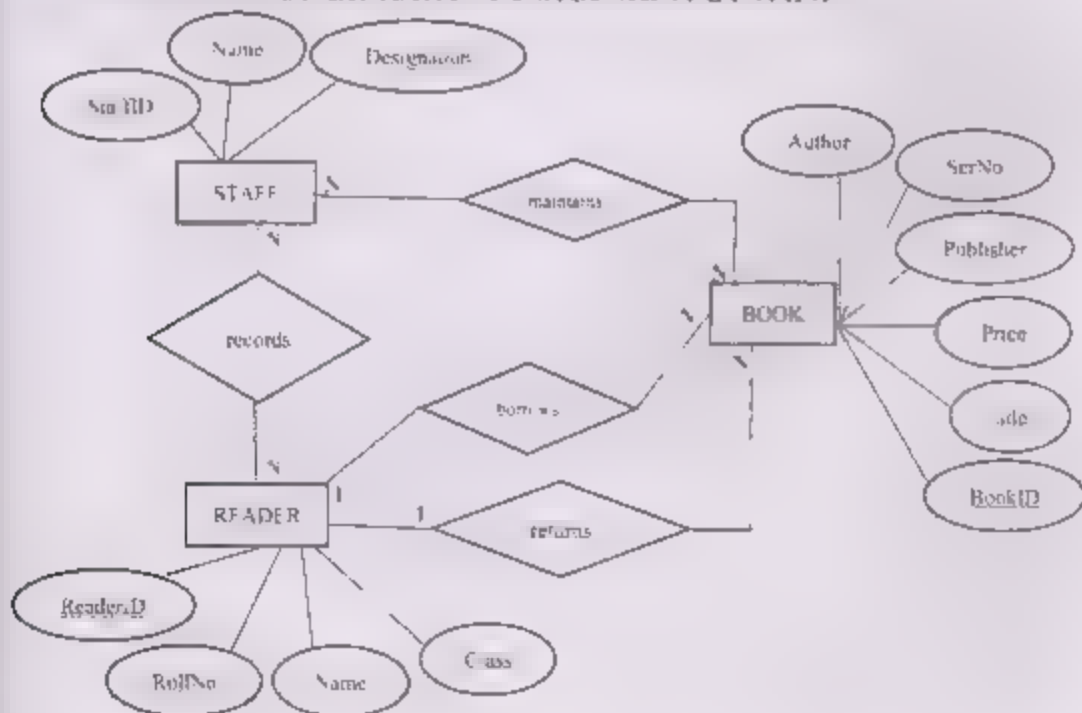


**Cardinality:** One PERSON can be a member of many CLUBS. One CLUB can have many members. Each side of the relationship has the cardinality of many.

**Modality:** One PERSON may or may not be a member of any CLUB. CLUBS must have at least one member. The modality is optional from PERSON to CLUB and mandatory from CLUB to PERSON side.

## EXAMPLES OF E-R DIAGRAM

### 1- E-R DIAGRAM OF LIBRARY MANAGEMENT SYSTEM



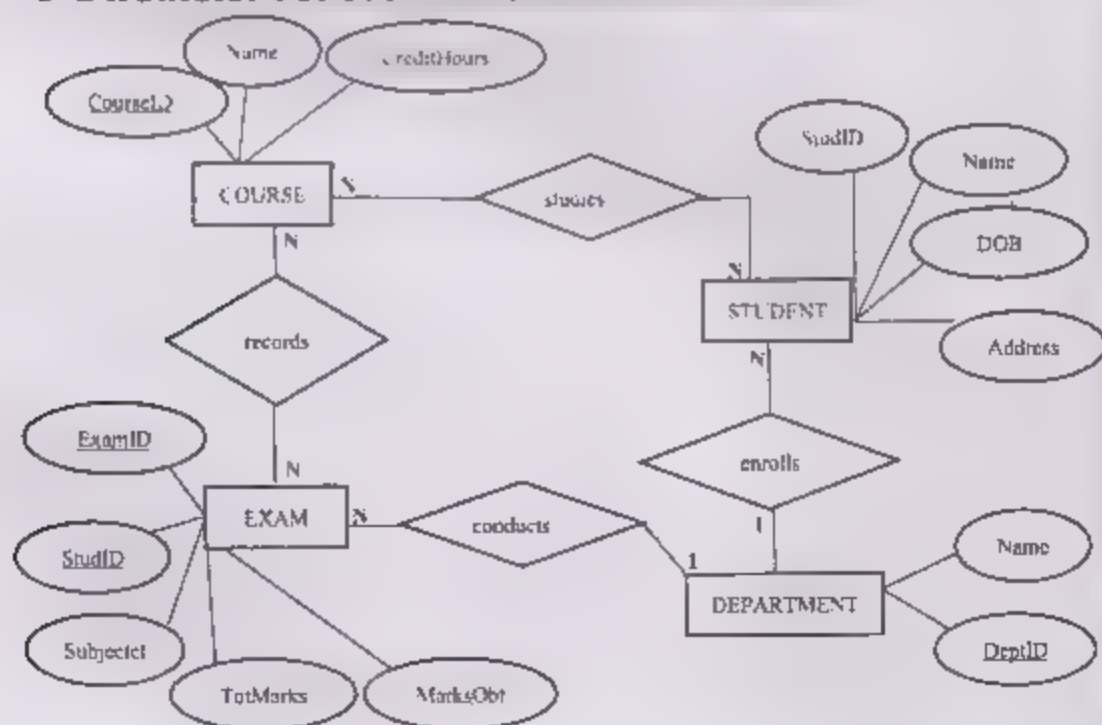
**ENTITIES:** The entities and their attributes in Library Management System are as follows

Entities	Description	Attributes
STAFF	It indicates the library staff	StaffId (primary key, Name, Designation
BOOK	It indicates available books in the library	BookID (primary key), title, Price, Publisher, SerNo, Author
READER	It indicates the book reader	ReaderId (primary key), Rol.No, Name, Class

**Relationships.**

1. The relationship between STAFF and BOOK is many-to-many because many staff members maintain many books.
2. The relationship between STAFF and READER is many-to-many because many staff members keep track of many readers
3. The relationship between READER and BOOK is one-to-many because a reader can borrow return one or more books. However, one book can be borrowed returned by only one reader at a time

**2- E-R DIAGRAM OF STUDENT MANAGEMENT SYSTEM**



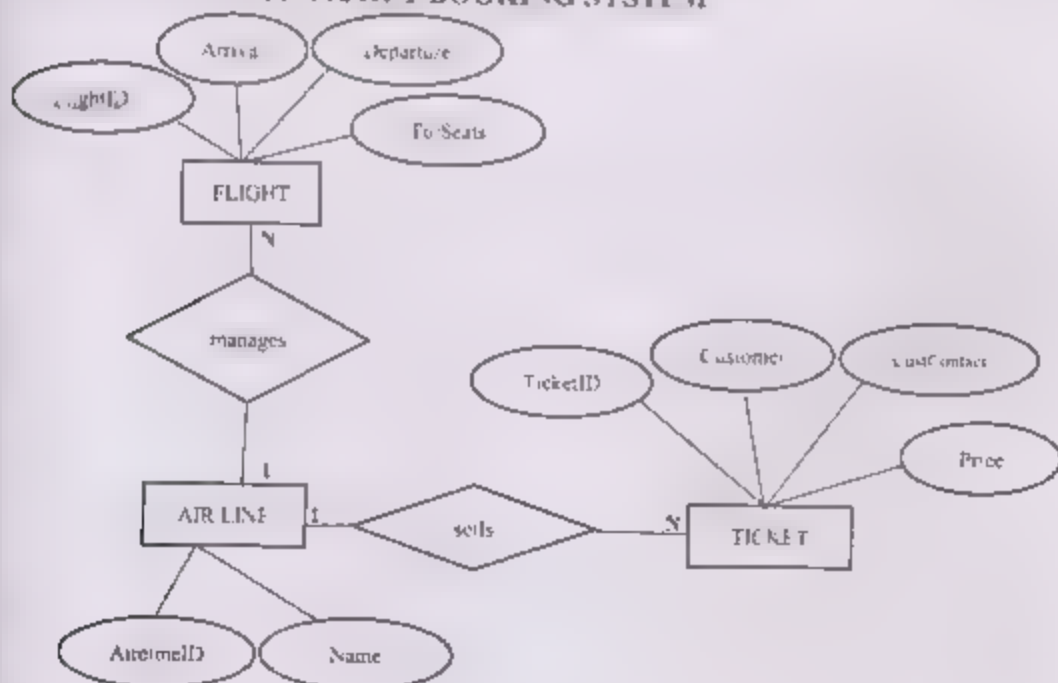
**ENTITIES:** The entities and their attributes in Student Management System are as follows.

Entities	Description	Attributes
COURSE	It indicates the course	CourseID (primary key), Name, CreditHours
STUDENT	It indicates the student	StudID (primary key), Name, DOB, Address
DEPARTMENT	It indicates the department	DeptID (primary key), Name
EXAM	It indicates the examination	ExamID (primary key), StudID, Subject, TotMarks, MarksObt.

### Relationships:

- 1- The relationship between STUDENT and COURSE is many-to-many because many students can study many courses.
- 2- The relationship between STUDENT and DEPARTMENT is one-to-many because one department can enroll many students.
- 3- The relationship between DEPARTMENT and EXAM is one-to-many because one department can conduct many exams.

### 3- E-R DIAGRAM OF TICKET BOOKING SYSTEM



**ENTITIES:** The entities and their attributes in Student Management System are as follows.

Entities	Description	Attributes
FLIGHT	It indicates the flight	FlightID (primary key), Arrival, Departure, ToSeats

		TotSeats.
AIRLINE	It indicates the airline	AirlineID (Primary key), Name
TICKET	It indicates the ticket	TicketID (primary key), Customer, CustContact, Price

#### Relationships:

- 1- The relationship between AIRLINE and FLIGHT is one-to-many because one airline manages many flights.
- 2 The relationship between AIRLINE and TICKET is one-to-many because one airline sells many tickets.

### 7.5- RELATIONAL SCHEMA

The structure of a database is known as relational schema. It includes tables, columns and relationships etc. It is used to construct the database.

#### **7.5.1- TRANSFORMATION OF E-R DIAGRAM TO RELATIONAL SCHEMA**

An ER diagram represents the conceptual and logical design of a database. It represents the real world entities and their attributes. It also indicates the relationships among different entities. The ER diagram is transformed to a relational schema to define the actual objects in the database. Following steps are used to transform the ER diagram to relational schema.

##### **1- Transforming Entities into Relational Schema**

An entity in the ER diagram is transformed to a table. All entities identified in the ER diagram are represented as tables in the relational schema. For example, entity CAR in an ER diagram becomes a CAR table.

##### **2- Transforming Attributes into Relational Schema**

An attribute in the ER diagram is transformed to a field or column. All attributes of any entity identified in the ER diagram are represented as fields in the relational schema. For example, an entity CAR may have attributes regno, model, color, and price etc. becomes fields in relational schema.

##### **3- Transforming Relationship into Relational Schema**

A relationship between entities in the ER diagram is transformed to a relationship between tables. A common key is used to make relationship between tables. The common key in primary table known as primary key and in secondary table it is known as foreign key.

##### **4- Transforming One-to-One relationship**

To represent the one-to-one relationship both the tables have primary key to join the tables.

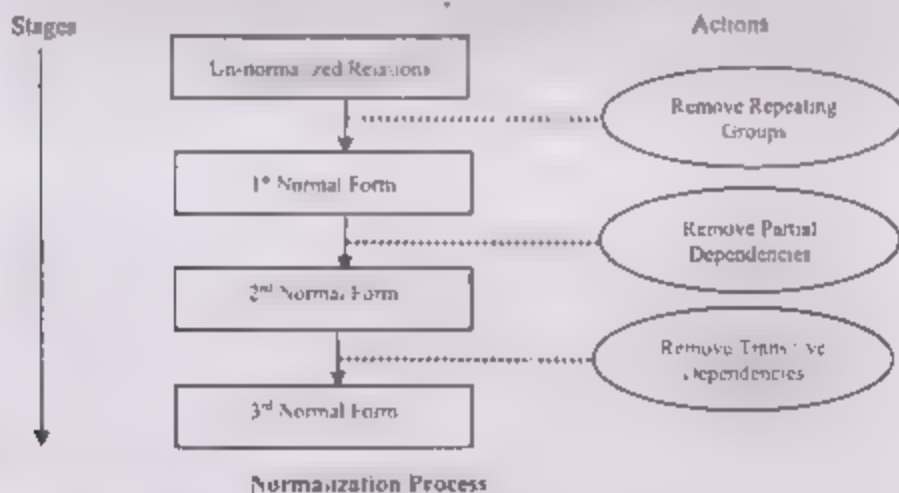
### 5- Transforming One-to-Many relationship

To represent the one-to-many relationship the common key which is joining the table will be primary key in the primary table and foreign key in the secondary table.

### 7.1.2- NORMALIZATION

Normalization is the process of organizing data in relational database in order to minimize duplication of information (data) and to safeguard the database against certain anomalies or irregularities. The basic purpose of normalization is to divide large relations/tables into smaller and well organized relations/tables and remove all kinds of anomalies from them.

The normalization process consists of series of steps or stages that are known as normal forms. There are 5 types of normal forms, the most commonly used forms are called 1NF, 2NF, and 3NF etc. Each normal form has certain conditions or rules that must be applied in order to bring the database in that particular normal form.



#### First Normal Form (1NF)

A relation is said to be in First Normal Form (1NF) if it satisfies the following conditions

- 1- If and only if each cell of a relation contains atomic value (only one value)
- 2- The relation does not contain any repeating groups

Example:

Suppose the data of students of a college is shown in the following relation.



*Student Relation*

RollNo	Name	City	Phone
111	Shahbaz	Lahore	7652373 7687898 03026787981
112	Imran	Multan	6576548 03338787888
113	Noman	Quetta	6676789 03017986567
114	Rashid	Islamabad	6867878

The above relation contains multi-valued attribute such as "Phone" that contains more than one value. We can overcome this problem by extending the row into multiple rows that contains multi values. So after extending the rows into multiple rows, the above data will be as follows

*Student Relation*

RollNo	Name	City	Phone
111	Shahbaz	Lahore	7652373
111	Shahbaz	Lahore	7687898
111	Shahbaz	Lahore	03026787981
112	Imran	Multan	6576548
112	Imran	Multan	03338787888
113	Noman	Quetta	6676789
113	Noman	Quetta	03017986567
114	Rashid	Islamabad	6867878

Now the repeating groups (fields) must be removed by dividing the relation into two relations as follows.

*Student Relation*

RollNo	Name	City
111	Shahbaz	Lahore
112	Imran	Multan
113	Noman	Quetta
114	Rashid	Islamabad

*Phone Relation*

RollNo	Phone
111	7652373
111	7687898
111	03026787981
112	6576548
112	03338787888
113	6676789
113	03017986567
114	6867878

The above relation is in first normal form, because every attribute is single valued for each tuple and there is no repeating group.

## SECOND NORMAL FORM (2NF)

A relation is said to be in Second Normal Form (2NF) if it satisfies the following conditions

- 1- If and only if, it is in first normal form.
- 2- There is no partial dependency

### Partial Dependency

A partial dependency occurs when a relation has a composite key and only one part of the key can be used to determine one or more attributes

Example.

Suppose the data of Employee a department is shown in the following table

<i>EmployeeRelation</i>					
<u>EmpID</u>	<u>Name</u>	<u>Dept</u>	<u>Salary</u>	<u>Course</u>	<u>Date Completed</u>
AC-201	Babar	Accounting	25000	Ms Office	19/06/2006
MK-101	Rashid	Marketing	26000	Management	09/01/2004
IT-301	Tahir	Computer	30000	Visual Basic	01/12/2009
IT-301	Tahir	Computer	30000	C++	09/08/2010
IT-301	Tahir	Computer	30000	Java	05/03/2011

The above relation contains a composite primary key of 'EmpID' and 'Course'. One part of the composite key 'EmpID' can be used to determine 'Name', 'Dept' and 'Salary'. It creates partial dependency in the relation. The partial dependency must be removed to convert a relation into second normal form. For this purpose, the relation is decomposed into two or more relations as follows.

<i>Employee Relation</i>				
<u>EmpID</u>	<u>Name</u>	<u>Dept</u>	<u>Salary</u>	
AC-201	Babar	Accounting	25000	
MK-101	Rashid	Marketing	26000	
IT-301	Tahir	Computer	30000	

<i>Course Relation</i>		
<u>EmpID</u>	<u>Course</u>	<u>Date Completed</u>
AC-201	Ms Office	19/06/2006
MK-101	Management	09/01/2004
IT-301	Visual Basic	01/12/2009
IT-301	C++	09/08/2010
IT-301	Java	05/03/2011

The above relations are in second normal form, because they are in 1 normal form and there is no partial dependency in the relations.

### THIRD NORMAL FORM (3NF)

A relation is said to be in Third Normal Form (3NF) if it satisfies the following conditions.

- 1- If and only, if it is in second normal form.
- 2- There is no transitive dependency

### Transitive Dependency

A transitive dependency occurs when a non-key attribute can be used to determine any other non-key attribute.

Example: Suppose the data of Sales of a company is shown in the following table

**Sales Relation**

CustNo	CustName	Salesman	Region
8023	Akbar	Ahmad	Quetta
9167	Babar	Bashir	Karachi
7924	Latif	Ahmad	Quetta
6837	Dawood	Khand	Lahore
9596	Ehsan	Bashir	Karachi
7018	Farooq	Munir	Sialkot

The above relation is not in 3NF because there is a transitive dependency, a non-key attribute i.e. Region can be used to determine other non-key attribute i.e. Salesman and vice versa. The transitive dependency can be removed by decomposing the relation Sales into two relations as follows.

**Sales Relation**

CustNo	CustName	Salesman
8023	Akbar	Ahmad
9167	Babar	Bashir
7924	Latif	Ahmad
6837	Dawood	Khand
9596	Ehsan	Bashir
7018	Farooq	Munir

**Region Relation**

Salesman	Region
Ahmad	Quetta
Bashir	Karachi
Khand	Lahore
Munir	Sialkot

The above relations are in third normal form, because they are in 2<sup>nd</sup> normal form and there is no transitive

dependency in the relations

## MULTIPLE CHOICE QUESTIONS

**Q.No. 1.(a) Choose the correct answer of the following MCQs**

1) Duplication of data in different files is called.

- A- Data inconsistency      B- Data redundancy  
C- Data overflow      D- Invalid data

2) If data is not updated in a file in file based data management systems, what types of problem will it cause?

- A- Data inconsistency      B- Data redundancy  
C- Data overflow      D- Invalid data

3) A record is also called.

- A- Attribute      B- Entity      C- Property      D- Tuple

4) An Attribute is also called:

- A- Record      B- Entity      C- Field      D- Relation

5) What is a thing of interest to an organization called about which data is to be held?

- A- Field      B- Relation      C- Entity      D- Attribute

6) In which type of database, data is held in tables and tables are linked by common field?

- A- Hierarchical Database      B- Network Database  
C- Relational Database      D- Object Oriented Database

7) In which database model data is organized in tree like structure?

- A- Hierarchical Database      B- Network Database

8. What refers to the maximum number of times an instance in one entity can be associated with instances in the related entity?  
 A- Relation B- Cardinality C- Modality D- E-R diagram
- 9) What refers to the minimum number of times an instance in one entity can be associated with instances in the related entity?  
 A- Relation B- Cardinality C- Modality D- E-R diagram
- 10) What is a key field called that is used in relationship between tables whose value matches a primary key in the other table? A- Candidate key B- Secondary key C- Alternate key D- Foreign key
- 11) Which of the following database object stores all the information of the database?  
 A- Table B- Query C- Report D- Form
- 12) \_\_\_\_\_ is a set of programs that is used to create, maintain and access database.  
 A- DBMS B- Data Dictionary C- Decision support system D- None
- 13) Which of the following is NOT a database management system?  
 A- MySQL B- Excel C- SQL Server D- Oracle
- 14) Which of the following is handled by DBMS?  
 A- Data Consistency B- Data Security C- Data independence D- All
- 15) Who is responsible to design, implement and maintain database?  
 A- End user B- Database Administrator  
 C- Application programmer D- Web designer
- 16) The label on or part of an E-R diagram are relationship attribute and  
 A- Cardinality B- Data flow C- Modularity D- Entity
- 17) The logical association among entities is called  
 A- Relationship B- Attribute C- Cardinality D- Modality
- 18) A person's name, birthday and social security number are examples of  
 A- Attributes B- Entities C- Relationships D- Descriptors
- 19) Which form of dependency is removed in 3NF?  
 A- Functional B- Non functional C- Associative D- Transitive
- 20) The goal of normalization is to:  
 A- get stable data structure B- Increase number of relations C- increase redundancy D- remove constraints

### Q.No. 1.(b) Write TRUE or FALSE.

Statement	TRUE or FALSE
i. DBMS is used to manage the database.	
ii. In RDBMS the data is stored in relations.	
iii. Row of a table is also known as attribute.	
iv. In ER diagram diamond shape is used to represent an entity.	
v. With the help of normalization we can reduce data redundancy.	

### EXERCISE QUESTIONS

#### Q2. Write short answers of the following questions

1. Differentiate between data and information. (Answer is on Page 96)

2. Define a database.

Ans. The database is an organized collection of stored data about particular object entity that is useful for the organization for which the database is developed.

3. What is a Database Management System(DBMS)? (Answer is on Page 98)

5. Define primary and secondary key. *(Answer is on Page 104)*

6. Define attribute and entity. *(Answer is on Page 103)*

7. What is meant by an instance?

Ans. Instance is a single occurrence of an entity type. For example STUDENT is an entity type and 'Imran' can be an instance of that entity type.

8. Differentiate between cardinality and modality. *(Answer is on Page 110)*

9. Why it is necessary to normalize a relational database?

Ans. It is necessary to normalize a database because user has to produce a simpler and more reliable database structure. Through normalization a user can minimize the redundancy and can remove the anomalies (problems) in the database.

### Q3. Write long answers of the following questions

1. What are the advantages using a DBMS over file management system? *(Answer is on Page 98)*

2. Define Database Administrator and describe the tasks performed by him. *(Answer is on Page 99)*

3. Define Database Model and explain its types. *(Answer is on Page 99)*

4. Describe the steps involve in database design. *(Answer is on Page 99)*

5. What is E-R diagram? Explain with examples. *(Answer is on Page 108)*

6. What is Normalization? Explain the following Normal forms: 1NF, 2NF, 3NF. *(Answer is on Page 117-119)*

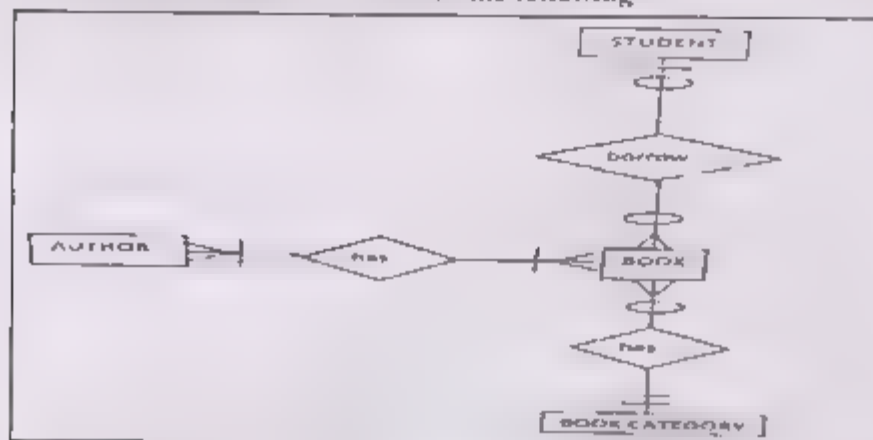
7. Select appropriate Primary key (s), Candidate key (s), and Secondary key (s) in the following table:

FacultyID	Name	Department	CNIC	Designation
1	Saira	Physics	61101-3265479-3	Lecturer
2	Musa	English	61-01-9876542-4	Assist Prof
2	Zaheer	Chemistry	61101-6124705-6	Lecturer

Ans.

Candidate Key (s)	Primary Key	Secondary Key (s)
FacultyID, CNIC	FacultyID	Name, Department, Designation

8. Understand the ERD and answer the following



i) List entities used in ER diagram

Ans. STUDENT, BOOK, AUTHOR AND BOOK CATEGORY

ii) Identify one example of one-to-many relationship.

Ans. STUDENT and BOOK has one-to-many relationship

iii) Indicate degree of relationship between BOOK and AUTHOR.

Ans. The degree of relationship between BOOK and AUTHOR is binary

iv) Identify the maximum cardinality between BOOK and BOOK CATEGORY.

Ans. The maximum cardinality between BOOK and BOOK CATEGORY is many-to-one

v) How many maximum STUDENTS can borrow a BOOK?

Ans. The maximum one STUDENT can borrow a BOOK

vi) How many minimum STUDENTS can borrow a BOOK?

Ans. The minimum zero STUDENT can borrow a BOOK

vii) How many minimum BOOKs are available in BOOK CATEGORY?

Ans. The minimum one BOOK is available in BOOK CATEGORY for every category



## UNIT 8

### DATABASE DEVELOPMENT

#### 8.1- DATABASE DEVELOPMENT

A database is developed to store, manage and retrieve data in an organized way. The relational databases are used to efficiently and effectively store and manipulate data in the database. The data in relational databases are stored in tables or relations. The main steps for developing database are as follows:

- Creating database objects such as tables, forms, queries and reports etc
- Defining keys in the tables such as primary key and foreign key
- Creating relationship between tables.

##### **8.1.1- DBMS / RDBMS**

A DBMS (Database Management System) RDBMS (Relational Database Management System) is a set of programs that are used to manage the database i.e. to create, maintain and manipulate database in an easy and efficient manner. Some common types of relational database management systems are as follows:

###### **Microsoft Access**

Microsoft Access is one of the very popular Relational Database Management Systems. It provides various features that are used to create and maintain databases. It can store and process large amount of data. It is very easy to use and learn. It provides graphical interface to create the database objects such as tables, forms, queries and reports very easily and quickly.

###### **OpenOffice Base**

OpenOffice Base is an open source database management system that is used to create and maintain databases. The built-in wizards (steps) are used to create tables, queries, forms and reports. It can be used to develop various databases such as accounting system, payroll system, inventory system and sales managements system etc.

###### **SQL Server**

SQL server is a relational database management system developed by Microsoft. It provides various features that are used to create and maintain databases. It allows developing databases that can be accessed from various devices. It can also be used to create and manage web based database. SQL server can be used to develop databases for small size organizations to large size organizations.

##### **8.1.2- MICROSOFT ACCESS**

Microsoft Access is the most popular and powerful DBMS / RDBMS. It is used to store

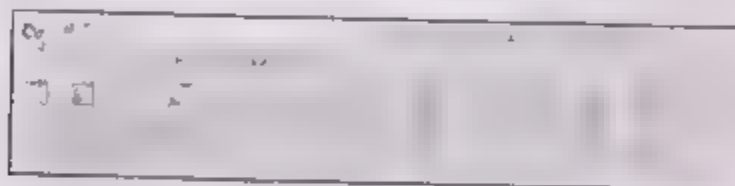
users to create database and to perform different operations on them. It provides Graphical User-Interface to create Tables, Queries, Forms and Reports etc.

### MICROSOFT ACCESS WINDOW

The Microsoft Access Window appears when a database is opened. It is used to access different elements to perform specific tasks. Some important elements of Access Window are as follows:

#### 1- Ribbon

The Ribbon is located at the top of access window below the title bar. It displays the tabs such as Home, Create, and External Data etc. Each tab has different buttons and lists to perform specific tasks. We can click any tab to display the related options. The Home tab contains the most frequently used commands.



Ribbon

#### 2- Microsoft Office Button

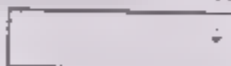
The Microsoft Office Button is located at the top left corner of Access window. It is used to perform commonly used tasks like saving, opening and closing a file.



Microsoft Office Button

#### 3- Quick Access Toolbar

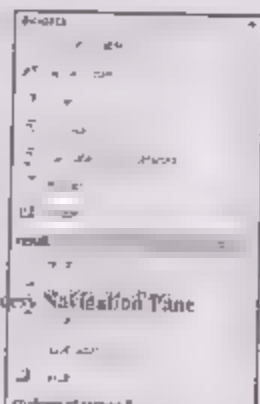
The Quick Access Toolbar is located at the right side of the Office Button. It provides access to some common tasks like Undo, Redo and Save.



Quick Access Button

#### 4- Access Navigation Pane

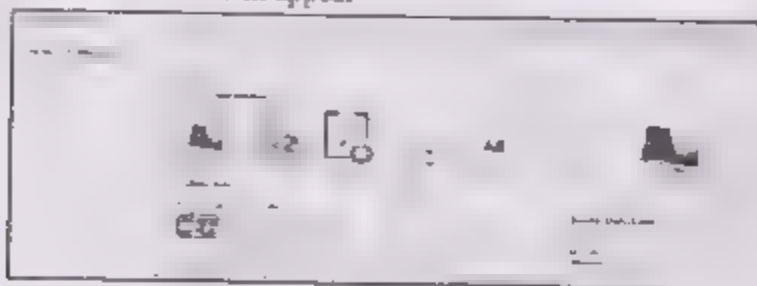
The Access navigation pane appears to the left side of the screen. It organizes all the objects that have been created in the database such as tables, forms, queries and reports. We can click the object in the navigation pane to open it in the main window. We can also rename and delete objects using navigation pane.



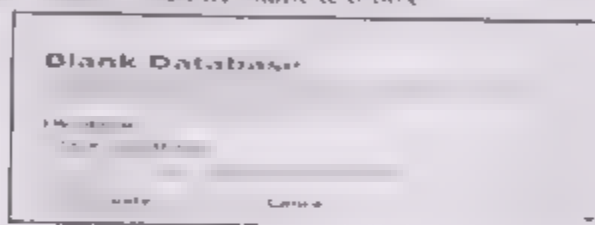
Access Navigation Pane

### 8.1.3- Procedure/Steps for creating blank database in Microsoft Access

- 1 Start Microsoft Office Access 2007. The Getting Started with Microsoft Office Access 2007 window will appear



- 2 Click Blank Database icon under New Blank Database
- 3 Type the file name in the File Name text box



- 4 Click Create. A new blank database will be created and opened

### 8.1.4- DATABASE OBJECTS

A component or element of a database is known as a database object. Most commonly used database objects in MS-Access are as follows:

1- Table

2- Queries

3- Forms

4- Reports

#### 1- Table

Table is the essential object of a database. It is also called relation. It consists of named columns and unnamed rows (tuples). The rows of the table represent the records. We define the structure of a table using design view. Entering and editing the table's data is commonly done by using datasheet view. We can apply different operations on data using table, like sorting and filtering etc. Table is also called the backend of database. Following is the example of a table.

Roll No	Name	Major Subject
111	Ali	Computer
112	Imran	Physics
113	Noman	Computer

## 2- Queries

Query means question or inquiry. Queries are used to gather selected information from database. The question like statements is written to retrieve selected data from one or more tables of the database. Each query consists of one or more criteria that we use to create a pattern or rules for selecting matching records. The queries may be used to make forms and reports as well. For example A table Student contains the following rows:

Roll No	Name	Marks
111	Ali	730
112	Amran	662
113	Noman	740
114	Ahsan	541

The user executes a query to retrieve the records of the students who got more than 700 marks. As a result, the query will display the following table:

Roll No	Name	Marks
111	Ali	730
113	Noman	740

## 3- Forms

Form is the very important object of database. It provides easy and attractive way to enter, edit, and display data from database tables or queries. A form is a window that displays a collection of controls like labels, text boxes, check boxes etc. for entering, viewing and modifying the information of database. Form is also called the front-end of the database.

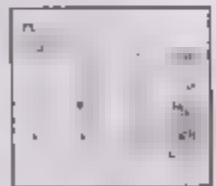
## 4- Reports

Reports are used for printing information from the database. A report retrieves the

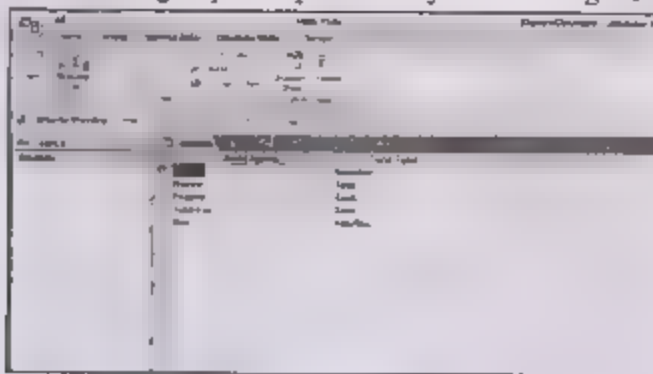
The screenshot shows a web browser window titled "1.6 demo". The main heading is "Result". Below it is a horizontal navigation bar with links: "Home", "About Us", "Contact Us", "Privacy Policy", "Terms & Conditions", and "FAQ". On the left side, there is a vertical sidebar menu with links: "Home", "About Us", "Contact Us", "Privacy Policy", "Terms & Conditions", and "FAQ". The main content area is currently blank.

Table is the very essential object of a database. It is a so called relation. It consists of named columns and unnamed rows (tuples). The rows of the table represent the records. We define the structure of a table using design view. Entering and editing the table's data is commonly done using datasheet view. We can apply different operations on data using table like sorting and filtering etc. Table is also called the backend of database.

1. Create a new database or open the already created database
2. Click Create tab.
3. Click Table Design in Tables group. The Table Design view window will appear.
4. Type the field name to determine field Name and select the appropriate data type under Data type.
5. The description is optional.
6. Repeat step 4 to add other fields of the table.



7. Now select the appropriate field to make it primary key by clicking Primary Key button in Tools group. The primary key will be assigned.



8. Click Save button on Quick Access toolbar. The Save As dialog box will appear.
9. Type the appropriate name for the table.



10. Click Ok. The table will be saved.

#### Procedure/Steps for entering data in a table

1. Open the desired database.
2. Double click the desired table icon in navigation pane. The table will be opened in data sheet view for entering the data.



#### 8.2.2- FIELD DATA TYPES USED IN MS-ACCESS

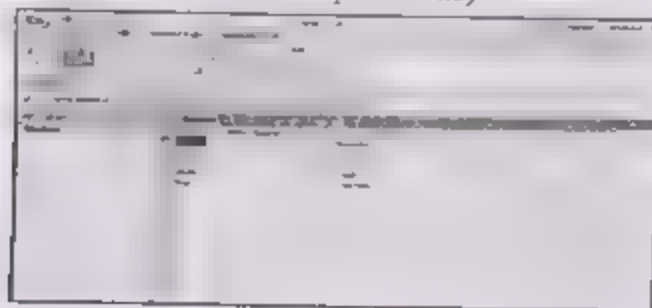
Data type is the type of value that will be entered into the fields. Following are the data types used in Ms-Access:



- **Text:** Text data type is the default type. It is used to store any combination of alphabets, numbers, and special characters up to a maximum of 255 characters per field. Access assigns a default length of 50 characters
- **Memo:** Memo data type is used for descriptive fields like comments. It is used to store lengthy text up to 65,535 characters
- **Number:** Number data type is used to store numeric values. We can perform arithmetic calculations on this type of data. MS-Access provides many subtypes of numeric data type. The subtype can be selected from Field Size property setting
- **Date/Time:** Date/Time data type is used to store a date, time, or combination of both. The Date/Time values can be displayed in different formats using Date/Time Format property
- **Currency:** Currency data type is used to store monetary values that can be set up to automatically include a currency sign and correct decimal and comma positions.
- **AutoNumber:** AutoNumber data type is used to generate the next number automatically. When a new record is created, Access automatically assigns a unique integer to the record in this field. The maximum number of records in a table that can use the AutoNumber field is slightly more than 2 billion.
- **Yes/No:** Yes/No data type is used to store Boolean values like True/False, Yes/No, On/Off, or other values that must be only one of two.

### 8.2.3- Procedure/Steps for assigning a Primary Key in a table

1. Open the required table in Design view
2. Select the desired field to make it primary key



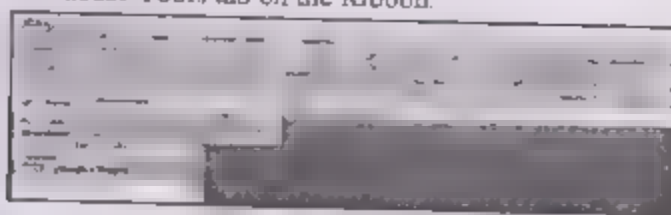
3. Click Primary Key button in Tools group. The primary key will be assigned.

### 8.2.4- TABLE RELATIONSHIPS

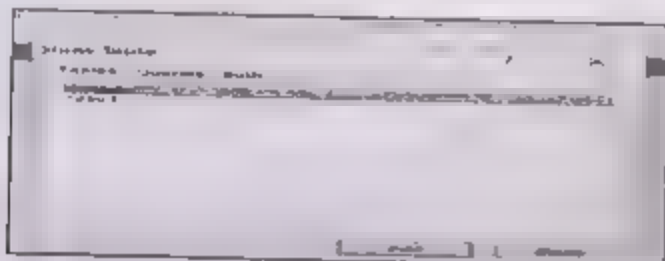
A relational database may contain many tables. Each table contains information about a particular object or topic. An association established between common fields in two tables is called relationship. Follow the steps below to set up a relational database.

### Procedure/Steps for creating Relationship

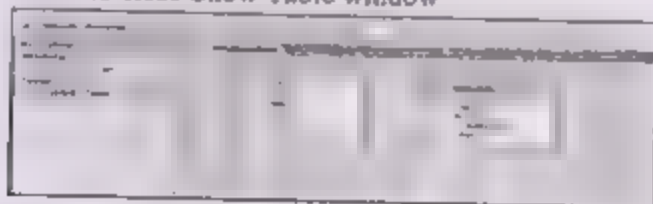
1. Open the desired database
2. Click Database Tools tab on the Ribbon.



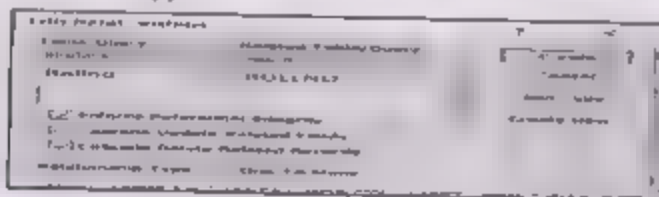
3. Click Relationships button on Show/Hide group. The Show Table window will appear



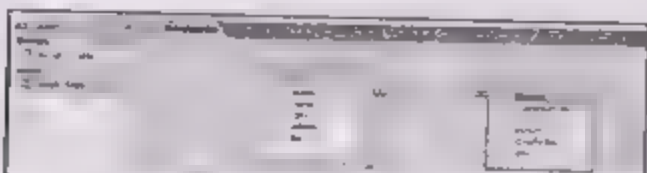
4. Select the desired table in from Show Table window and click Add
5. Repeat step 4 to add any other table
6. Click Close to close Show Table window



7. Click the desired field in a table and drag it on the related field of the other table in Relationship window and release the mouse. The Edit Relationships dialog box will appear



8. Select Enforce Referential Integrity, Cascade Update Related Fields, and Cascade Delete Related Records check boxes
9. Click Create in Edit Relationship dialog box. The relationship will be created.



## REFERENTIAL INTEGRITY

Referential integrity is a set of rules that Access uses to make sure that relationships between records in related tables are valid, and that you do not accidentally delete or change related data. Moreover you cannot enter a value in a foreign key field that does not have a corresponding value in primary key field in the related table.

### Cascade Updates Related Fields

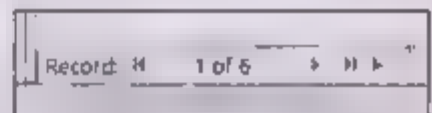
If you select the Cascade Update Related Fields check box when you define a relationship, then any time you change the primary key of a record in the primary table, Microsoft Access automatically updates the primary key to the new value in all related records in secondary table. For example, there are two tables Student and Result. Student is the parent table and Result is the child table. If you change the value of the field RollNo in the Student table, then all the related fields in Result table is also automatically changed.

### Cascade Delete Related Records

If you select the Cascade Delete Related Records check box when you define a relationship, then any time you delete records in the primary table, Access automatically deletes related records in the related secondary table. For example, there are two tables Student and Result. Student is the parent table and Result is the child table. If you delete the record of RollNo 5 in the Student table, then all the related records of Roll\_No 5 in Result table is also automatically deleted.

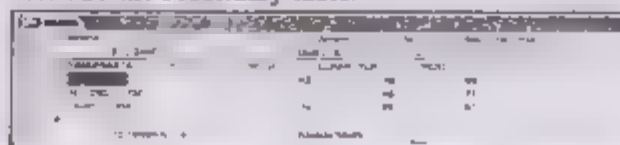
## 8.2.5- NAVIGATING THROUGH RECORDS IN A TABLE

The navigation buttons of a table are at the bottom left corner. It allows user to move to the first, previous, next and last record in the table. It can also be used to create a new record. The user can directly move to a specific record as well.



## 8.2.6- Procedure/Steps for adding records in a related table

1. Open the primary table by clicking it in the Navigation Pane.
2. Click the "+" symbol at the left end of the first row in primary table.
3. Add data for the related record of secondary table. You can add more than one examination in the secondary since there is one-to-many relationship between the primary table and the secondary table.



4. When you click the "+" symbol it changes to "-" symbol. If you click again you will return to the Student table and the "-" symbol will change to "+" symbol again.

### **8.3- WORKING WITH FORMS**

Form is very important object of database. It provides very easy and attractive way to enter, edit, and display data from database tables. A form is a window that displays a collection of controls like labels, text boxes, check boxes etc for entering, viewing and modifying the information of database. Form is also called the front end of the database.

#### **Uses of Form**

1. We can add, modify and delete data in the database.
2. We can arrange the controls on a form according to our requirement that makes it easy to read and access the data.
3. We can search the required data.
4. We can display or run advanced database objects such as pictures, animations, sounds, and video clips in form.

#### **Advantages of using Form**

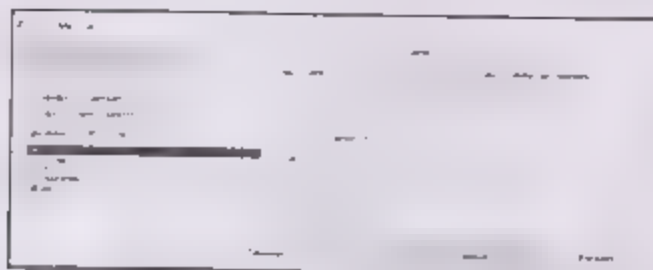
1. It contains simple graphical elements which makes form user friendly and simple easy to use.
2. A user can use the database without any technical knowledge of databases.
3. It saves time because data can be entered very quickly.
4. Access provides different types of forms to display data in different formats.

#### **8.3.1- Procedure/Steps for creating a Form**

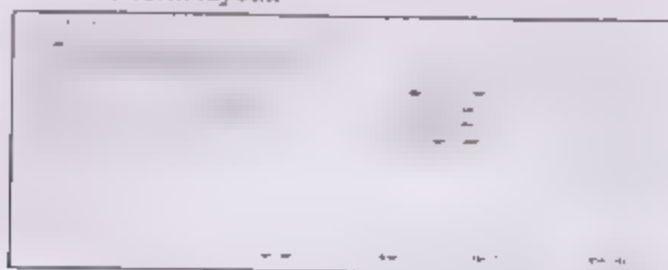
1. Click Create tab.
2. Click More Forms button in Forms group. The More Forms list appears.



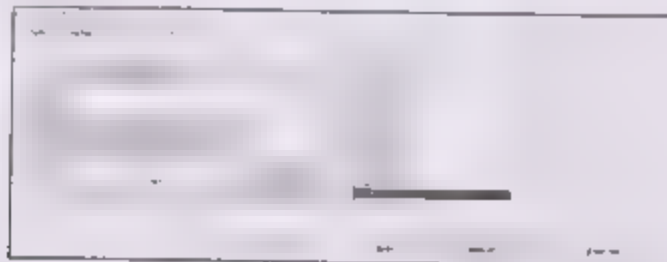
3. Click Form Wizard. The Form Wizard will open.
4. Click Tables/Queries list. A list of tables and queries appears.
5. Click desired table or query to create the form. The fields of the selected table or query will appear in Available Fields list box.



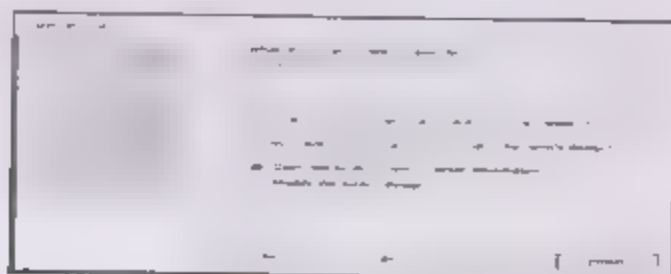
6. Add the desired fields to Selected Fields list box. The fields will appear in Selected Fields list box.
7. Click Next.
8. Select the desired form layout.



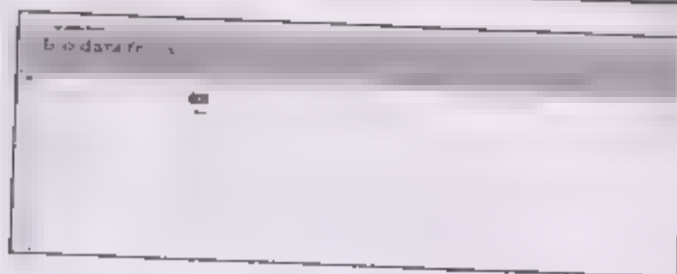
9. Click Next.



10. Select the desired form style.
11. Click Next.

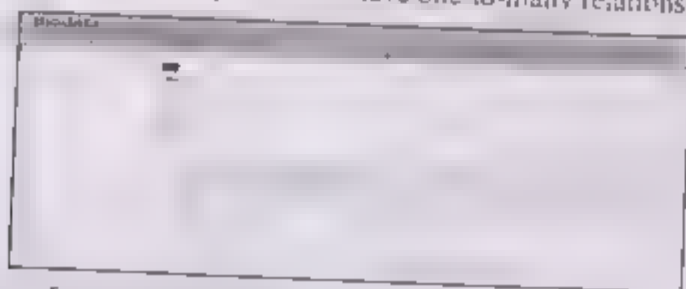


12. Type the name of the form.
13. Click Finish. The form wizard will be closed and the new form will be created and opened.



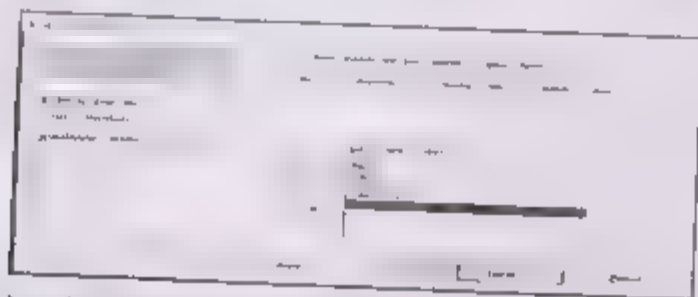
### SUBFORM

A form within another form is called sub form. It is also known as child form. A sub form is placed in a parent form, called the main form. Sub forms are particularly useful to display data from tables and queries that have one-to-many relationships.



**Procedure / Steps for creating a Form and sub-form at once.**

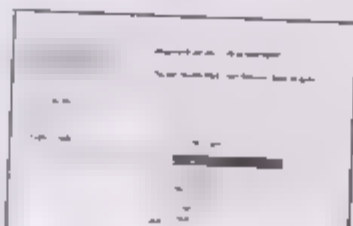
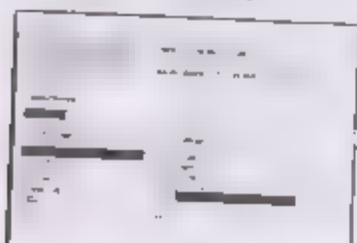
1. Click Create tab.
2. Click More Forms button in Forms group.
3. Click Form Wizard. The Form Wizard will open.
4. Click Tables/Queries list.
5. Select the first table or query from which the main form will display data from Tables/Queries menu.



6. Select

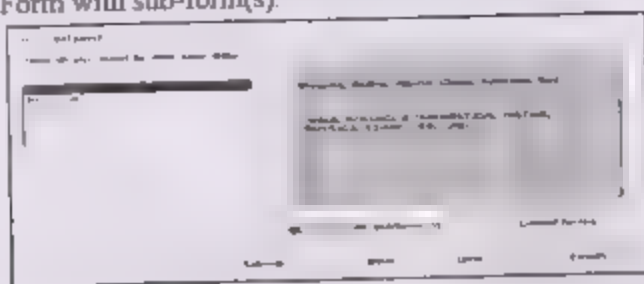
fields that should appear on form by highlighting and clicking single arrow > button.

7. Select another table or query from Tables/Queries drop-down menu and choose the fields that should appear on form.

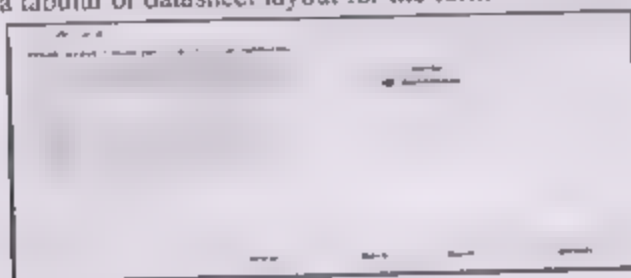




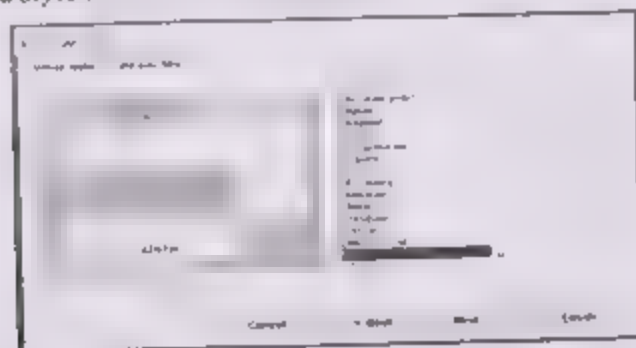
8. Click Next after selecting all the fields.
9. Select Form with sub-form(s).



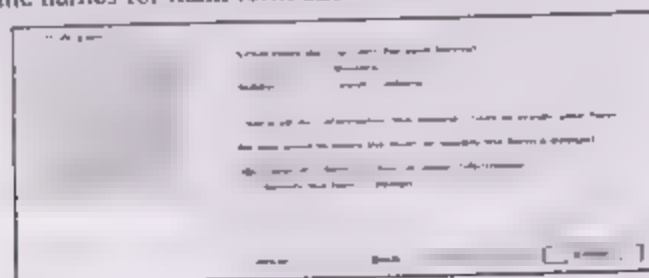
10. Click Next.
11. Select a tabular or datasheet layout for the form and click Next



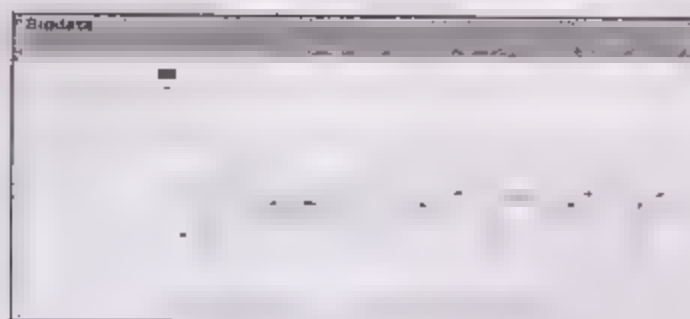
12. Select a style for the form and click Next



13. Enter the names for main form and subform



14. Click Finish to create a form and a sub-form



### 8.3.2- TYPES OF FORM VIEWS

Ms-Access provides 3 basic types of forms depending on the layout. These are

- 1- Columnar form      2- Tabular form      3 Datasheet form

#### 1- Columnar Form

Columnar form is used to display one record at a time. It displays each field in a separate line with a label to its left. The label represents the names of field and the textboxes represents the value of the fields. The following figure displays a columnar form.

#### 2- Tabular Form

Tabular form is used to display many records at a time. It displays each record in a horizontal row with field labels (names) at the top of the form. Each new row represents a new record. The following figure displays a Tabular form.

rno	name	address
112	SULMAN	QUETTA
113	SULEMAN	LAHORE
121	ALI	QUETTA
0		

### 3- Datasheet Form

Datasheet form is used to display many record at a time. It displays records in datasheet view of Access. Each row in this form displays one record of the table. The labels are displayed on top of each column. The following figure displays a datasheet form.

	mp	name	addrees
▶	112	IMRAN	QUETTA
	114	SULEMAN	LAHORE
	121	ALI	QUETTA
*	0		

## 8.4- WORKING WITH QUFRIES

Query means question or inquiry. Queries are used to gather selected information from database. The question like statements is written to retrieve selected data from one or more tables of the database. The resulting collection of records, called a **dynaset** (short for dynamic subset), is saved as a database object and can therefore be easily used in the future. Each query consists of one or more criteria that we use to create a pattern or rules for selecting matching records. The queries may be used to make forms and reports as well.

### Uses / Advantages of Query

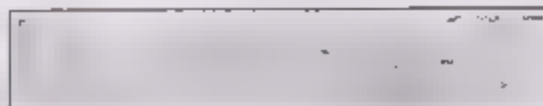
1. Information from one or more than one tables can be retrieved at once.
2. The result of query can be used for forms and for creating reports.
3. Calculated fields is also created using queries.
4. Using query we can sort the records in a specific order.

#### 8.4.1- WAYS OF CREATING QUERIES

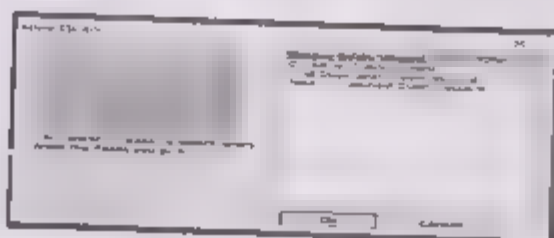
We can create a large variety of queries in Access. To create queries users commonly use Query Wizard and Query Design. These two methods for creating queries are given in the other group of Create tab of Access ribbon.

#### 8.4.2- Procedure/Steps to create Simple Query using Query Wizard

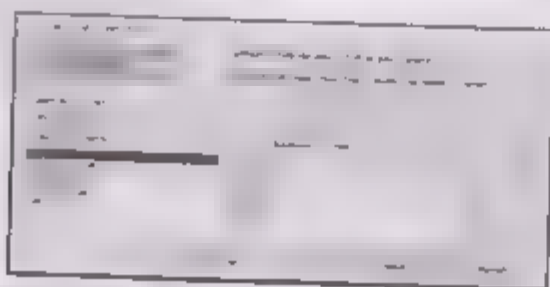
1. Open the desired database.
2. Click Create tab.



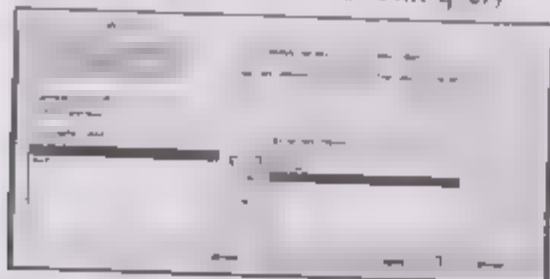
3. Select Query Wizard in Other groups. The New Query dialog box will appear.



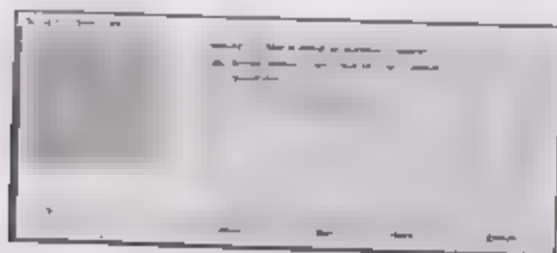
- 4 Select Simple Query Wizard and click OK. The Simple Query Wizard will appear
- 5 Select Tables/Queries drop down list. A list of available tables and queries will appear
- 6 Select the desired table. All fields of the selected table will appear in the Available field box.



- 7 Click the field that is to be included in the query



- 8 Click > button. The selected field will move to the Selected Fields list
- 9 Repeat steps 7 to 8 until all the required fields are added to the Selected Fields list.
- 10 Click Next.



- 11 Select Finish. The query will run and displays the record. (It will display all the record of the table because we didn't specify any criteria)

## TYPES OF QUERIES

In MS-Access we can use following type of queries

### 1- Select Queries

A Select query is used to extract data from table based on specified criteria. It is the most common type of query. It may retrieve data from more than one table.

### 2- Action Queries

An Action query is used to make changes in specified records on an existing table. It is also used to create a new table. There are four types of action queries

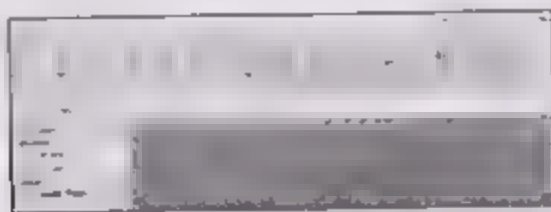
- **Delete query:** It is used to delete a group of records from one or more tables.
- **Update query:** It is used to make changes to a group of records in one or more tables
- **Append query:** It is used to add a group of records from one or more tables to end of one of more tables
- **Make table query:** It is used to create a new table and copy selected records in it

## SELECT QUERY

A Select query is used to extract data from table based on specified criteria. It is the most common type of query. It may retrieve data from more than one table

**Procedure/Steps for creating Select query using Query Design**

1. Open database
2. Click Create tab.
3. Click Query Design button in other group. The Show Table dialog box will appear



4. Click the table whose fields are required to be included in the query



5. Click

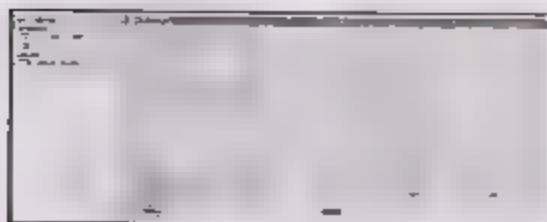
Add

6. Click

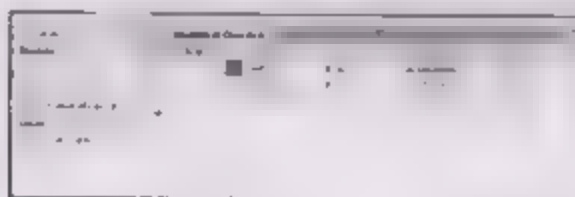
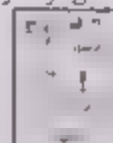
Close to close Show

Table dialog box. The Query Designer window will appear. The upper portion of the window contains the selected tables. The lower portion displays design grid that contains different options to create query.

7. Double Click the field to be added in the query



- 8 Repeat the above step to add other fields to be included in the query
- 9 Give the condition in Criteria field (In this example Criteria is given in Class field that is XI-A)
- 10 Click Save button on Quick Access Toolbar to save the query by given the query name "Student of class XI-A"
- 11 After saving the query Click Run in Results group Query Tools Design tab. The result will appear (the records of only those students will appear who belongs to class XI-A)



### Wildcards

Wild cards are the special characters that are used in queries to specify the criteria in different ways based on some pattern. Wildcard characters used in Ms-Access are as follows.

Wildcard	Meaning	Example
*	The asterisk is the wildcard that represents a number of characters	To specify any name starts with F the criteria can be specified as F*
?	The question mark is a wildcard that takes the place of a single letter	To specify any text that starts with F and followed by any single character, the criteria can be F?

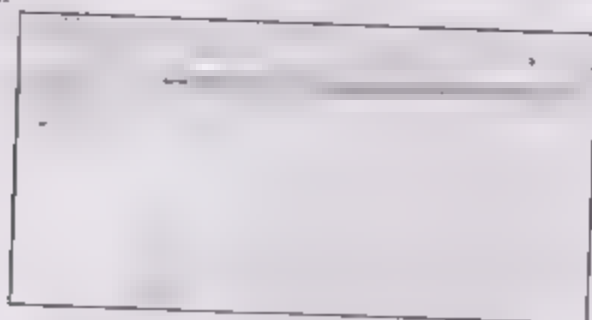
### DELETE QUERY

A Delete query is used to delete record or a group of records from one or more tables. We cannot undo the action of deleting the record using a delete query. An easy way to create a Delete query is to create a Select query and then convert it into Delete query.

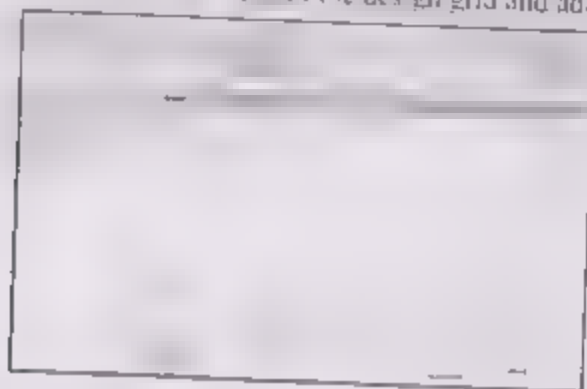


**Procedure Steps for creating Delete query**

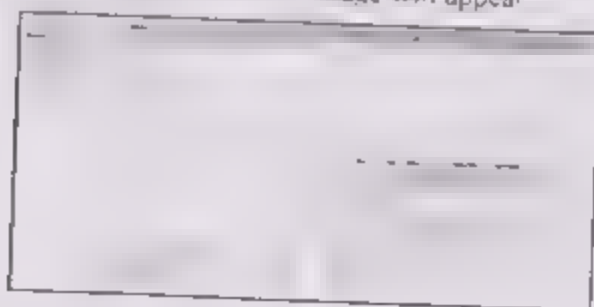
1. First create the Select Query with the criteria ISLAMABAD in the City column



2. On the Design tab in the Query Type group Click Delete. This will hide the show row in the lower section of the design grid and add the "Delete" row



3. To delete the selected records Click Run in the Results group Design tab. The confirmation message will appear



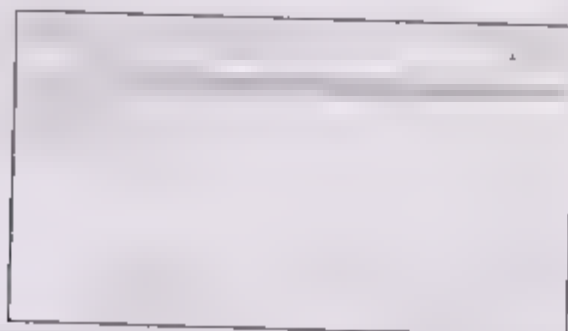
4. Click yes to confirm the deletion.

**UPDATE QUERY**

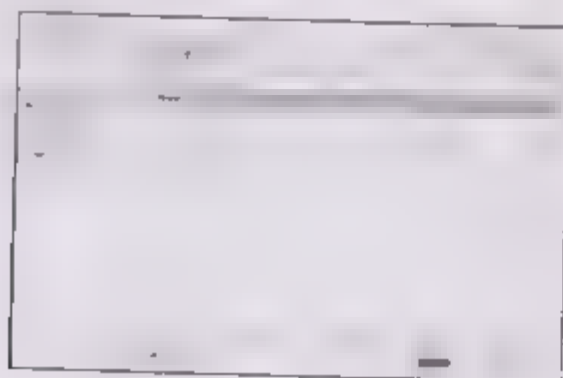
Update query is used to change the value of data in existing table. It can be used to update a large number of records at once. For example we want to change the address "QUETTA" of all the students who belong to "ISLAMABAD". We cannot undo the action of updating the records using a update query. An easy way to create Update query is to create a Select query and then convert it into Update query.

**Procedure Steps for creating Delete query**

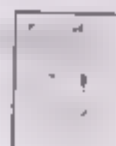
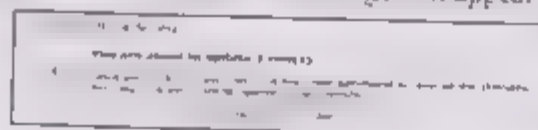
1. First create the Select Query with the criteria ISLAMABAD in the City column



2. On the Design tab in the Query Type group Click Update. This will add the "Update to" row in the design grid. Type "QUETTA" in city column in the "Update to" row



3. To update the selected records Click Run in the Results group Design tab. The confirmation message will appear



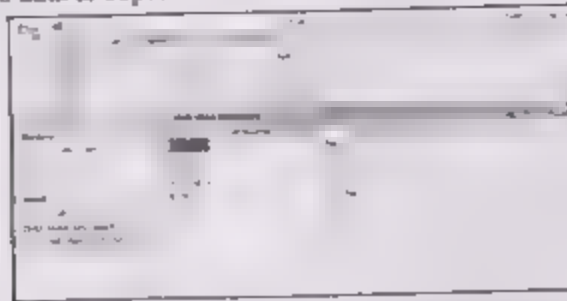
4. Click yes to confirm the updation.

**APPEND QUERY**

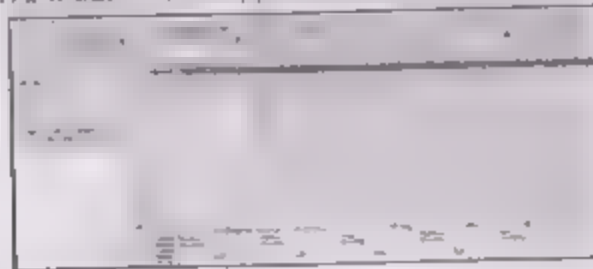
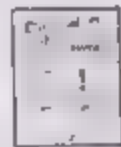
Append query is used to select the records from one or more tables and copy them to an existing table. The data types of the fields in the source table should be similar to the data types of the destination table. A field with numeric data can be appended to a text field but text field cannot be appended to number field. An easy way to create Append query is to create a Select query and then convert it into Append query.

**Procedure / Steps for creating Delete query**

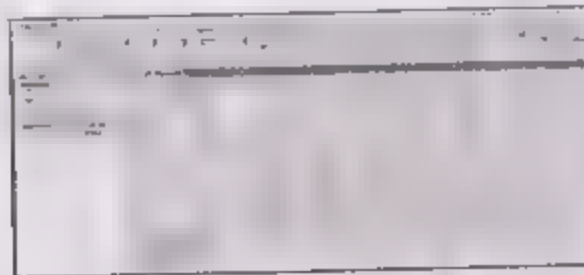
- 1 First create a destination table with same fields and data types as source table where the data is copied



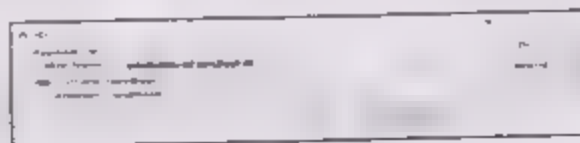
- 2 On the Create tab button in Other group The Show Table dialog box will appear.
- 3 Click the tables that contain the records to be copied.
- 4 Click Add.
- 5 Click close to close Show Table dialog box The table will appear as a window in the upper section of the query designer



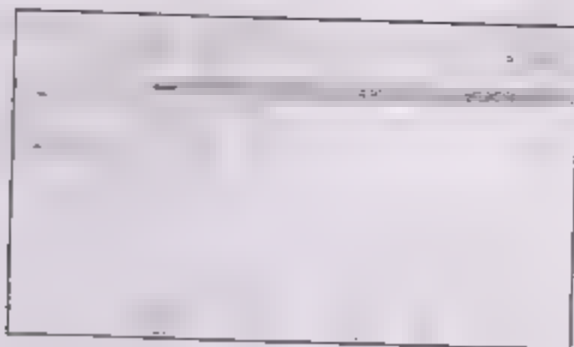
- 6 Give the condition in Criteria field if required



- 7 Click Append in Query Type group on Design tab The Append dialog box will appear

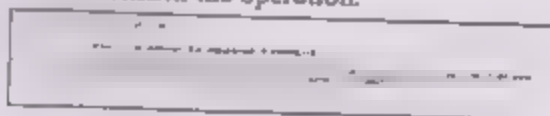
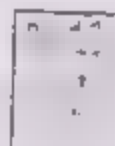


- 8 Specify whether to append records to table in current or different database
- 9 Select Current Database in Append dialog box and select destination table from

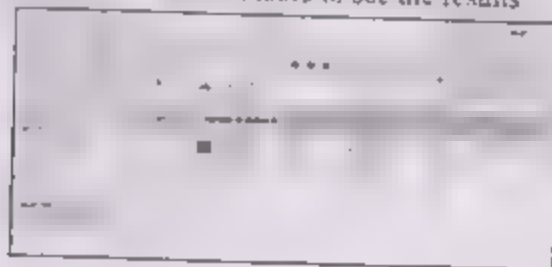


10. Click Run in Results group on Design tab. A confirmation message will appear.

11. Click Yes to confirm the operation.



12. Now open the destination table to see the results.

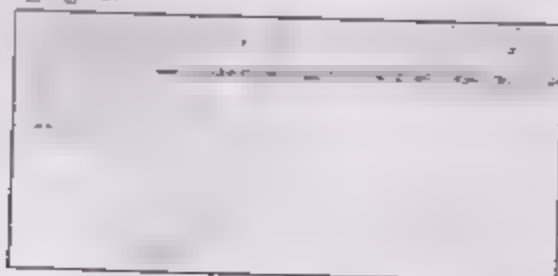


### MAKE-TABLE QUERY

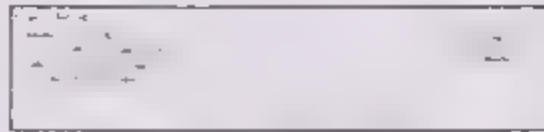
The make-table query is used to retrieve selected records from a table and copies them to a new table. The new table can be in the current or another database. An easy way to create make-table query is to create a Select query and then convert it into Append query.

#### Procedure/Steps for creating Delete query

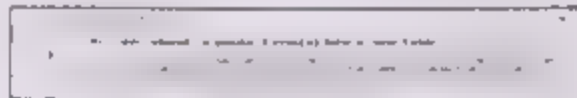
- First create a Select query that has a criteria XI A in the Class field column in the query design grid.



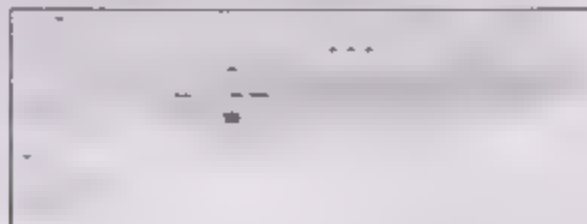
2. Click Make Table in the Query Type group of Design tab. The Make-Table dialog box will appear.



3. Specify whether to make-table in current or different database.
4. Enter a name for the new table in the Table Name box.
5. Select Current Database in Make Table dialog box to place new table in the current database and click OK.
6. Click Run in Results group on Design tab. A confirmation message will appear.
7. Click Yes to confirm the operation.



8. Now open the new table to see the results.



## CALCULATED FIELD

Calculated fields are a special type of field. The value of the field is not stored within the database table, but is instead calculated or computed based on the values of other fields within that record. The calculation is called a formula.

Formulas consist of a combination of field names, constants, operators etc. A field name is the name of the field that you specified when that field was created. For example, if you added a field to your database that was named marks\_obtained, to use that field in a calculation you would type:

[marks\_obtained] \* physics + computer + maths]

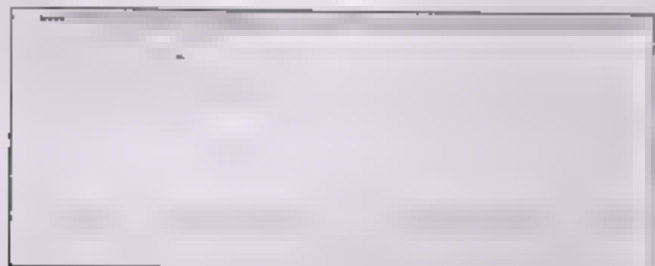
The square brackets are required to identify all field names.

## Procedure / Steps for creating calculated field in the query

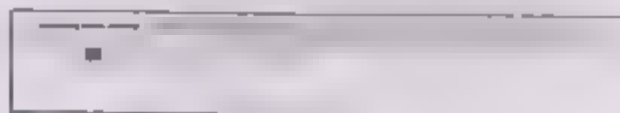
1. Click the create tab on the Access Ribbon.
2. Click Query Design in the Other group to bring the query design window.
3. Add both Biodata table and Result tables and close the Show Table dialog box.
4. Double click the RollNo, Name and Class in the box labeled Biodata and double click Examination\_Maths\_Physics, and Computer in the box labeled

Result

- 5 To set up criteria enter 33 below all the subjects and FIRST TERM below Examination column.



- 6 To create the MARKS\_OBTAINED field, click on the field list on the left and drag it to the first blank column on the right side of the design grid. It will express MARKS\_OBTAINED PHYSICS COMPUTER MATHS.
- 7 Save the query by clicking the save icon on the top left corner of the screen and give it the name Calculating Marks Obtained.
- 8 Now run the query you will see the query results.



### 8.5- GENERATING REPORTS

Reports are used for pulling information from the database. They are the output of the database. A report retrieves the data from database tables and presents it in a predefined manner. The main difference between Forms and reports is that using forms we can enter new data as well as change the existing data of database but reports are only used for printing information and do not allow the user to enter or change the data of the database.

#### **Advantages of using Report**

1. A Report can be used to retrieve the data from the database tables and presents it in a predefined manner.
2. We can format the data accessed from database through queries and print on the paper.
3. We can use graphics and charts in Report.
4. We can also send generated report as e-mail.

#### **TYPES OF REPORT LAYOUTS**

The standard types of reports in MS-Access are as follows:

- 1- Columnar Report
- 2- Tabular Report



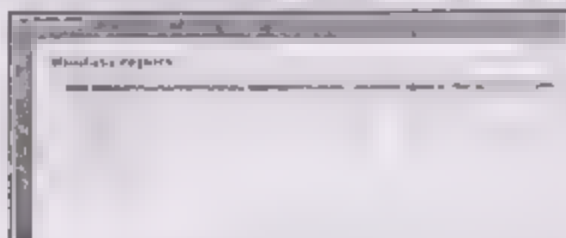
### 1- Columnar Report

The columnar reports display the value of each field of a record of table or query in one long column of textboxes. The labels indicate the name of the fields. The columnar report spreads the information for a single record over many rows.



### 2- Tabular Report

The tabular reports display columns for each field of the records in rows under column header. Many records can be printed using tabular report in one page.

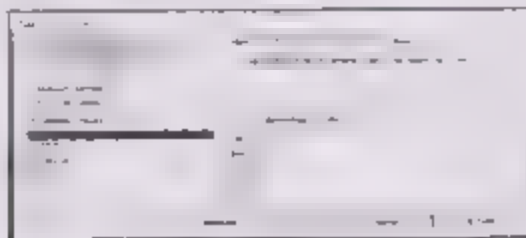


#### 8.5.1- Procedure/Steps for creating a Report using report wizard.

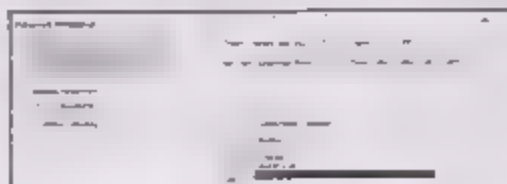
- 1 Click Create tab on the Ribbon
- 2 Click Report wizard button in Reports group. The report wizard will appear.



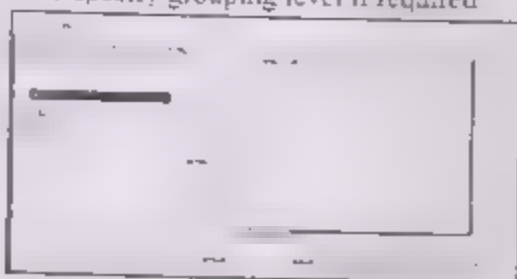
- 3 Select the required table from Tables/Queries list box. The fields of table will appear in available Fields box.



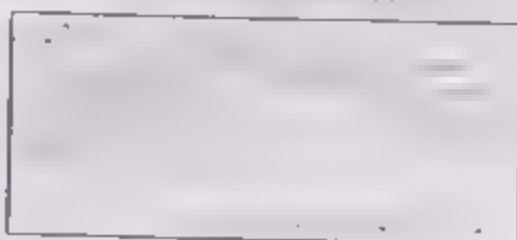
- 4 Click on >> button to transfer all fields from Available Fields list to Selected field list box.



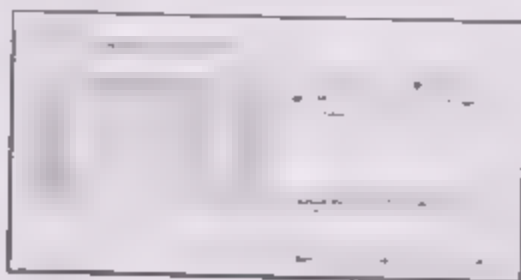
- 5 Click Next button.
- 6 Select any field to specify grouping level if required



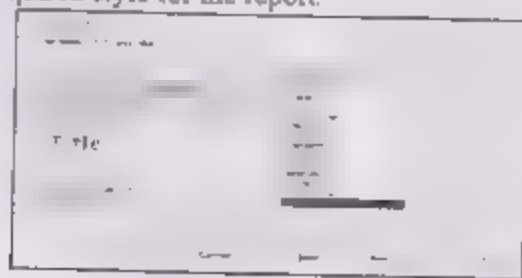
- 7 Click Next button. The next window will appear



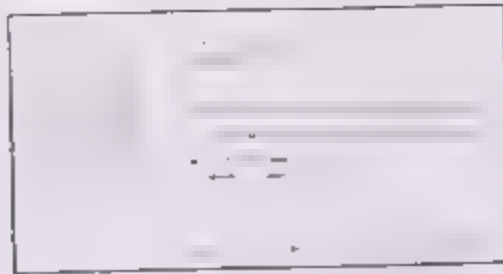
8. Select the field to sort the records.
9. Click Next button.
10. Select the required layout and orientation option



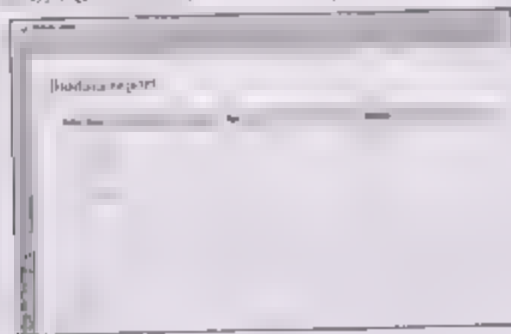
11. Click Next button.
12. Select the required style for the report.



13. Type the desired title as the name of the report



14. Click Finish button to review the report



### Difference between Form and Report

	FORM	REPORT
1)	The basic purpose of form is to input data in tables.	The basic purpose of report is to print data from tables or queries.
2)	The data in forms can be deleted.	The data in reports cannot be deleted.
3)	The data in form can be modified.	The data in reports cannot be modified.
4)	The user can add new data through form.	The user cannot add new data through report.

### MULTIPLE CHOICE QUESTIONS

Q) Select the best answer of the following MCQs

- Which of the following is used to gather information based on one or more criteria?  
A- Table      B- Form      C- Query      D- Report
- Which data type is used to provide descriptive comments?  
A- Text      B- Memo      C- AutoNumber      D- Yes/No
- Selecting records in a table which match a given criteria known as  
A- Sorting data      B- Searching data      C- Updating data      D- Filtering data
- The maximum number of records in a table that can use AutoNumber field is slightly more than  
A- 1 million      B- 1 Billion      C- 2 Billion      D- 3 Billion
- Which database object stores all the information of a database?  
A- Table      B- Form      C- Query      D- Report

- 6) What is the default value of number of characters of text data type in MS Access?  
A- 30 B- 40 C- 50 D- 60
- 7) Which query is used to add records from a table to another table?  
A- Select query B- Update query C- Append query D- Make table query
- 8) Which query is used to change data in existing records?  
A- Select query B- Update query C- Append query D- Make table query
- 9) In which tab of Access ribbon Relationship can be used?  
A- Home B- Create C- External D- Database Tools
- 10) In which tab of Access ribbon Query Design tool is used?  
A- Home B- Create C- External D- Database Tools
- 11) A database is made up of primary components called  
A- Objects B- Properties C- Commands D- Procedure
- 12) Which of the following is not a type of report that have been created?  
A- Ribbon B- Access Navigation C- Quick Access D- Quick Access Toolbar
- 13) In Access, the data in tables is entered in  
A- Design view B- Normal view C- Data Entry view D- Layout view
- 14) Which of the following is not a type of MS Access?  
A- Memo B- Currency C- Name D- Text
- 15) A field with a value of either one or two values  
A- Yes/No B- True/False C- Plus/Minus D- On/Off
- 16) In Access, which of the following is used to display single record at a time?  
A- Tabular B- Columnar C- Datasheet D- None
- 17) In Access, which of the following is a collection of individual design elements called?  
A- Compact B- Properties C- Windows D- Files
- 18) Which of the following is not a type of query?  
A- Select query B- Parameter query C- Make table query D- Append query
- 19) Query can be used to select data from:  
A- Single table B- Multiple table C- Both A & B D- None
- 20) A report may be based on  
A- A table but not a query B- A query but not a table C- Both a table and a query D- None

#### Q.No. 1.(b) Write TRUE or FALSE.

Statement	TRUE or FALSE
Table is an object that is used to print the database information	
i) We can create relationship between tables in MS Access	
ii) Columnar form is used to display many records at a time	
iii) Queries are used to gather selected information	
iv) We can create two layouts of report	

#### EXERCISE QUESTIONS

##### Q2 Write short answers of the following questions

1- Which tasks can be performed using Microsoft Office Button? (Ans is on Page 125)

2- Describe various ways of deleting records in a table.

Ans. The records in the table can be deleted by following ways

- Selecting the records and pressing delete key
- Right clicking the record and selecting Delete Record option
- Selecting the records and clicking Delete button in Record menu on Home tab

3- What are the advantages of using forms? *(Answer is on Page 133)*

4- What is meant by referential integrity? *(Answer is on Page 132)*

5- Describe how records can be added and deleted by using forms.

Ans. The records can be added by clicking New option in Records group on Home tab and the records can be deleted by clicking Delete option in Records group on Home tab.

6- Describe columnar, tabular and datasheet layouts of forms.  
*(Answer is on Page 137-138)*

7- What is the use of Query Design grid?

Ans. The Query Design grid is used to design different types of queries. It can be used to select fields to be included in the result and to specify the criteria for the queries. It also has an option to sort the result of the queries.

8- What is OpenOffice Base? *(Answer is on Page 124)*

9- Difference between update and append query.

Ans. The Update Query is used to make changes to a group of records in one or more tables whereas the Append Query is used to add a group of records from one or more table to the end of one or more tables.

10- Differentiate between columnar and tabular reports. *(Ans is on Page 148)*

**Q3. Write long answers of the following questions**

1- Explain the following database objects. *(Answer is on Page 126-127)*

i) Tables ii) Forms iii) Queries iv) Reports

2- Explain the field data types used in Access. *(Answer is on Page 129-130)*

3- Describe how forms are created. *(Answer is on Page 133)*

4- Write the steps for creating relationships between tables. *(Answer is on Page 131)*

5- Describe the types of queries that can be created in Access. *(Answer is on Page 140)*

**ANSWER OF MCQs**

QNo1.(a)

Unit No.1

1) C	2) C	3) B	4) C	5) A	6) D	7) A
8) B	9) C	10) A	11) B	12) D	13) A	14) C
15) D	16) D	17) D	18) A	19) A	20) B	

QNo1.(b)

i- TRUE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE

QNo1.(a)

Unit No. 2

1) C	2) C	3) A	4) B	5) C	6) B	7) D
8) A	9) C	10) D	11) A	12) A	13) B	14) D
15) C	16) D	17) A	18) A	19) B	20) D	

QNo1.(b)

i- FALSE

ii- TRUE

iii- FALSE

iv- TRUE

v- FALSE

QNo1.(a)

Unit No. 3

1) B	2) D	3) C	4) A	5) C	6) B	7) A
8) D	9) C	10) D	11) A	12) A	13) B	14) D
15) D	16) C	17) D	18) A	19) A	20) A	

QNo1.(b)

i- TRUE

ii- FALSE

iii- FALSE

iv- TRUE

v- FALSE

QNo1.(a)

Unit No. 4

1) A	2) D	3) D	4) A	5) C	6) C	7) A
8) D	9) D	10) D	11) B	12) B	13) D	14) C
15) C	16) A	17) A	18) A	19) A	20) D	

QNo1.(b)

i- FALSE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE

QNo1.(a)

Unit No. 5

1) B	2) D	3) D	4) A	5) D	6) B	7) D
8) C	9) A	10) B	11) B	12) A	13) D	14) C
15) D	16) A	17) C	18) A	19) A	20) B	

QNo1.(b)

i- TRUE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE

QNo1.(a)

Unit No. 6

1) B	2) D	3) C	4) C	5) A	6) A	7) A
8) C	9) C	10) B	11) A	12) C	13) A	14) A
15) A	16) B	17) C	18) B	19) A	20) A	

QNo1.(b)

i- TRUE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE

QNo1.(a)

Unit No. 7

1) B	2) A	3) D	4) C	5) C	6) C	7) A
8) B	9) C	10) D	11) A	12) A	13) B	14) D
15) B	16) D	17) A	18) A	19) D	20) A	

QNo1.(b)

i- TRUE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE

QNo1.(a)

Unit No. 8

1) C	2) B	3) C	4) C	5) A	6) C	7) C
8) B	9) D	10) B	11) A	12) B	13) C	14) C
15) A	16) B	17) A	18) B	19) C	20) C	

QNo1.(b)

i- FALSE

ii- TRUE

iii- FALSE

iv- FALSE

v- TRUE



1	ALU	Arithmetic Logic Unit
2	AMD	Advanced Micro Devices
3	ARPANET	Advanced Research Project Network
4	ASCII	American Standard Codes for Information Interchange
5	ATM	Automatic Teller Machine
6	BIOS	Basic Input Output System
7	BIPS	Billion Instructions Per Second
8	BIT	Binary digit
9	CD ROM	Compact Disc Read Only Memory
10	CISC	Complex Instruction Set Computer
11	CLI	Command Line Interface
12	CPU	Central Processing Unit
13	CRT	Cathode Ray Tube
14	CSMA/CD	Carrier Sense Multiple Access with Collision Detection
15	CU	Control Unit
16	DAR	Data Address Register
17	DBA	Database Administrator
18	DBMS	Database Management System
19	DIMM	Dual In-line Memory Module
20	DO5	Disk Operating System
21	DR	Data Register
22	DRAM	Dynamic Random Access Memory
23	DSL	Digital Subscriber Line
24	DVD	Digital Versatile Video Disc
25	EEPROM	Electrically Erasable Programmable Read Only Memory
26	EMI	Electro Magnetic Interference
27	EPROM	Erasable Programmable Read Only Memory
28	FTP	File Transfer Protocol
29	GPS	Global Positioning System
30	GUI	Graphical User Interface
31	HTML	Hyper Text Markup Language
32	HTTP	Hyper Text Transfer Protocol
33	IBM	International Business Machine
34	IC	Integrated Circuit
35	IEEE	Institute of Electrical and Electronics Engineers
36	IR	Instruction Register
37	ISDN	Integrated Services Digital Network
38	ISDN	Integrated Services Digital Network
39	ISO	International Standard Organization
40	ISP	Internet Service Provider
41	IT	Information Technology
42	LAN	Local Area Network
43	LASER	Light Amplification by Stimulated Emission of Radiation
44	LCD	Liquid Crystal Display
45	LED	Light Emitting Diodes
46	LSI	Large Scale Integration
47	LEO	Low Earth Orbit
48	MAN	Metropolitan Area Network
49	MIPS	Million Instructions Per Second
50	MEQ	Medium Earth Orbit

52	NIC	Network Interface Card
53	OCR	Optical Character Reader Recognition
54	OSI	Open System Interconnection
55	PC	Program Counter
56	PDA	Personal Digital Assistant
57	PIXEL	Picture Element
58	POST	Power On Self Test
59	PSDN	Public Switched Telephone Network
60	RAM	Random Access Memory
61	RISC	Reduced Instruction Set Computer
62	ROM	Read Only Memory
63	SATA	Serial Advanced Technology Attachment
64	SDRAM	Synchronous Dynamic RAM
65	SIMM	Single In-line Memory Module
66	SRAM	Static Random Access Memory
67	TCP/IP	Transmission Control Protocol Internet Protocol
68	TIPS	Trillion Instructions Per Second
69	UPC	Universal Product Code
70	URL	Universal Resource Locator
71	VPN	Virtual Private Network
72	WAN	Wide Area Network
73	WAP	Wireless Access Point
74	Wi-Fi	Wireless Fidelity
75	Wi-MAX	Worldwide Interoperability for Microwave Access
76	WWW	World Wide Web

## **IMPORTANT ABBREVIATIONS**

## **COMPUTER SCIENCE (SYLLABUS)**

### **NATIONAL CURRICULUM 2009 (For Grade 11)**

#### **UNIT 1**

#### **OVERVIEW OF COMPUTER SYSTEM**

##### **1.1 Introduction to Computer**

###### **i) Identify computing device**

ii) Define the term computer and its basic operation (I/O, Storage, and Process)

iii) Define and classify (Micro computer, Mainframe, Super, Mobile Computing)

###### **iv) Differentiate Hardware and Software with example**

##### **1.2 Computer Software**

Describe types of software (System software, Application software)

###### **i) Describe the types of system software:**

Operating System, Device Driver, Utility Software

Language Processor

###### **iii) Describe Application software**

Productivity software, Business software, Entertainment software, Education software

###### **iv) Elaborate the following terms**

Licensed software, Open source software, Shareware, Freeware

###### **v) Define firmware**

##### **1.3 Computer Hardware**

###### **i) Define the Computer hardware (Input/output, Memory, CPU)**

###### **ii) Describe the input devices**

Keyboard, pointing devices, Mouse, Track ball, Joystick, Touch Screen, Light Pen, Touch Pad

Microphone, Digital camera, Scanners, Hand held, scanner, Flat bed scanner, Optical scanner,

Magnetic card/Devices based system

###### **iii) Describe the following output devices**

Monitors, CRT, LCDs

Printers, Impact printer (Dot Matrix, Drum, Chain)

Non Impact Printer (DeskJet, Laser)

Plotters, Speakers

###### **iv) Differentiate between soft copy and hard copy**

#### **UNIT 2**

#### **COMPUTER MEMORY**

##### **2.1 Introduction**

Define the following: Bit, Byte (KB, MB, GB, TB), Memory Word

##### **2.2 Main Memory i) Explain the difference between chip memory and magnetic memory**

###### **ii) Differentiate between volatile and non-volatile memory**

###### **iii) Explain the following fundamental types of computer memory**

Internal processing memory, Cache (L1, L2), Register, RAM, Static RAM, Dynamic RAM

ROM, PROM, EPROM, EEPROM

##### **2.3 Secondary Memory**

###### **i) Explain secondary storage devices**

###### **ii) Explain the difference between sequential access and direct access**

iii) Describe the following types of magnetic memory, and optical disk with their working mechanism, advantages and disadvantages:

Magnetic tapes, Magnetic disks, Optical disks (CD, DVD, Blue Ray)

###### **iv) Describe the following chip Memories with advantages and disadvantages**

Flash Memory, Memory Cards

#### **UNIT 3**

#### **CENTRAL PROCESSING UNIT**

##### **3.1 Inside CPU**

###### **i) Describe the basic components of CPU**

Arithmetic and Logic Unit (ALU), Control Unit (CU), Registers, Cache, Internal Buses

- iii) Describe the functions of the following types of registers  
General purpose registers: Accumulator (AC), Base register, Counter register, Data Register (DR), Special purpose registers: Instruction Register (IR), Memory Address Register (MAR), Memory Buffer Register (MBR), Program Counter (PC).
- iv) Explain the system bus and its types: Data bus, Address bus, Control bus
- 3.2 CPU Operations i) Define instruction and its types
- ii) Explain instruction format
- iii) Describe instruction cycle (fetch, decode, execute)
- iv) Describe CISC and RISC architecture
- v) Differentiate the following processors with reference to Clock speed, Bits, Bus width, Cache, Architecture: Intel P4, AMD Athlon

#### UNIT 4 INSIDE SYSTEM UNIT

- 4.1 Computer Casing/System Unit
- i) Differentiate between the CPU and system unit
- ii) Identify the Computer Casing and its types
- iii) Explore the system unit  
Power Supply, Mother Board, BIOS (Basic Input Output System), Port, Expansion Slot (AGP, PCI, PCI Express), Ribbon Cable (Data Cable, IDE, SATA 1-2, Floppy Cable), Memory Slot, Disk Controller - Cooling System, Buses
- 4.2 Ports and Slots on the Motherboard
- i) Describe the following Ports:  
Serial Ports, Parallel Port, PS/2 Port, USB port, Fire Wire port
- ii) Identify the following expansion cards:  
Sound card, Video Card, Modem card, Network card
- iii) Memory chips: SIMM, DIMM, SDRAM, DDR

#### UNIT 5 NETWORK COMMUNICATION AND PROTOCOLS

- 5.1 Introduction Explain the following  
Basic Network Components (Sender, Receiver, Medium)  
Modes of Communication (simplex, half duplex, full duplex, Synchronous, Asynchronous)  
Communication Media (Guided, Un-Guided)  
Communication Devices (Switch, Router, Gateway)  
Network Architecture (Client/Server, Peer to Peer)  
Network Types (LAN, MAN, WAN, VPN)  
Network Topologies (Star, Ring, Bus, Mesh)
- 5.2 Data Communication standards
- i) Identify the purpose of a communication standard
- ii) Define OSI model and explain concept of its layers
- iii) Provide examples of protocols and devices on every layer of OSI Model
- 5.3 TCP/IP i) Describe TCP/IP as a Protocol suite used for communication over the Internet by discussing  
Architecture, Ports, Application
- ii) Compare the TCP suite with OSI model
- iii) Differentiate between circuit switching and Packet switching
- iv) Describe IP Addressing scheme (Classes, Subnets, Masks)

#### UNIT 6 WIRELESS COMMUNICATIONS

- 6.1 Introduction
- i) Explain a wireless network
- ii) Explain the advantages and disadvantages of wireless networks
- iii) Define the following terms  
Radio signals, Radio transmitter, Access Point, Line of sight communication
- iv) Differentiate between short distance and long distance wireless communications
- 6.2 Short Distance Wireless Communications
- i) Explain the various types of short distance wireless technologies:

Wi-Fi, Wi Max, Bluetooth, Infra-red,

### 6.3 Long Distance Wireless Communication

Explain the following types of long distance wireless communications

Cellular Communication, Global Positioning System (GPS), Geostationary Earth Orbit (GEO),

Medium Earth Orbit (MEO), Low Earth Orbit (LEO)

### 6.4 Mobile Device communication

i) Explain the requirements of mobile communication

ii) Identify features and limitations of mobile communication system

iii) Explain the architecture for communications over mobile devices

Web Protocol stack (HTTP/TCP/IP), WML, WAP

## UNIT 7

### DATABASE FUNDAMENTALS

7.1 Introduction : Explain the difference between data and information

i) Explain the file management system

ii) Define database

iv) Explain the database management system

vi) Identify the advantages of database management system over the file management system

vi) Identify the role of a Database Administrator (DBA)

vii) Describe the following types of database models.

Hierarchical database, Network database, Relational database, Object-Oriented database, Object Relational Database

viii) Explain the following types of database languages for relational databases

Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL)

### 7.2 Basic Database Terminologies

Define the following terms related to relational databases

Field, Attribute, Column, Record, Tuple, Row, Table, Relation, View, Data type, Key

### 7.3 Planning a Database

Explain the following steps for designing a database

Problem identification, Feasibility study, Requirement Analysis, Identifying Entities and Attributes, Assigning names to Tables and Columns

### 7.4 Data Modeling and Entity-Relationship Diagram

i) Explain the following through pictorial examples:

Entity, Attribute, Relationship, Keys

ii) Explain the cardinalities and modalities with the help of pictorial examples

iii) Draw Entity-Relationship (ER) diagrams for the systems like

Library Management System, Student Management System, Ticket Booking System

### 7.5 Relational Schema

i) Transform the ER models to the Relational Schema

Transforming Entities, Transforming Attributes, Transforming Relationships

ii) Normalize relations up to third normal form including integrity rules

## UNIT 8

### DATABASE DEVELOPMENT

### 8.1 Introduction

i) Identify various relational database management systems

(MS Access, Open Office Base, SQL Server)

ii) Select any suitable DBMS as an application for creating and maintaining databases

iii) Explain the steps involved to create and save a database

iv) Explain the following in Database Environment:

Database Toolbar, Database Window, Objects, Tables, Queries, Forms, Reports

### 8.2 Working with Tables

i) Explain different ways of creating, saving and editing a table in database

ii) Identify various available data types

iii) Create a primary key and foreign key in the tables



- iv) Create and edit relationship among tables
  - v) Use navigation buttons to navigate through records in a table
  - vi) Add, modify and delete records from a table
- 8.3 Working with Forms**
- i) Explain different ways of creating, saving and editing a form in a database
  - ii) Know different Form views
  - iii) Use the navigation buttons to navigate through records displayed in a Form
  - iv) Add, modify and delete records
  - v) Use Form controls
- 8.4 Working with queries and commands**
- i) Explain different ways of creating, saving and editing a query in a database
  - ii) Use following queries on database  
SELECT( Where, Group by, Order by), UPDATE, DELETE, INSERT, ALTER
- 8.5 Generating Reports**
- i) Use the report wizard to generate a report
  - ii) Use various report layouts/styles to produce reports
  - iii) Set the sort order of records that will appear on the report
  - iv) Customized reports using queries (macros and arithmetic expressions)
  - v) Save, view and print the report

### PRACTICALS

Activities for Grade 11

1. Recognition of component in System Unit
2. Resource Sharing (Hardware and Software using networking)

#### Database

Design and develop a database containing:

- 1- Tables (3 to 5) 2- Queries (4 to 6) 3- Forms (upto 10) 4- Reports (5 to 10)  
Including all requirements of DBMS like relationships and main interface

### WEIGHTAGE FOR VARIOUS CHAPTERS FOR PAPER

Unit Title	Weight-age %
1. Overview of Computer System	10%
2. Computer Memory	10%
3. Central Processing Unit	10%
4. Inside System Unit	15%
5. Network Communication and Protocols	10%
6. Wireless Communications	10%
7. Database Fundamentals	15%
8. Database Development	20%

**"Fundamentals of Operating System, SDLC & C++" for GRADE 12 by Sheikh Faisal Manzoor is also available at bookshops.**

**For Suggestions**

**email: [misterfaisal.fq@gmail.com](mailto:misterfaisal.fq@gmail.com)**

**Facebook ID: Sheikh Faisal. Cell : 03337926605**

**FEDERAL BOARD OF INTERMEDIATE & SECONDARY EDUCATION**  
**INTERMEDIATE (ANNUAL) EXAMINATION, 2021**  
**COMPUTER SCIENCE HSSC-II**

Time allowed: 2-40 hours

Total Marks Sections B, C &amp; D

**SECTION- B (Marks 18)**

**Q.2** Answer any SIX parts. All parts carry equal marks. (6 x 3 = 18)

- (i) Differentiate between system software and application software with one example of each.
- (ii) What is freeware? Also give an example.
- (iii) Write down three features of minicomputer computers.
- (iv) How RAM size affects the processing speed of a computer system?
- (v) For what purpose EEPROM is used? Give example also.
- (vi) How is data stored in Optical memory?
- (vii) What is the function of Control Unit? Illustrate with diagram.
- (viii) Differentiate between CISC and RISC.
- (ix) What is register? Write down the purposes of Instruction Register and Program Counter.

**SECTION- C (Marks 18)**

**Q.3** Answer any SIX parts. All parts carry equal marks. (6 x 3 = 18)

- (i) Compare Synchronous and Asynchronous transmissions.
- (ii) What is the purpose of session layer of OSI model?
- (iii) Briefly explain network topology. Write down two features of bus topology.
- (iv) What are the characteristics of LAN?
- (v) Write down three advantages of wireless network.
- (vi) Give three advantages of DBMS over file management system.
- (vii) Draw an ER Diagram that shows cardinality and modality for the following situation:  
Each company employee may be assigned to one or more projects or may not be assigned to a project. A project may have at least one employee assigned and may have several employees assigned.
- (viii) What are Primary and Foreign keys? Give examples.
- (ix) What is query? List four types of queries.

**SECTION- D (Marks 18)**

**Note:** Answer any THREE parts. All parts carry equal marks. (3 x 6 = 18)

**Q.4** Explain the following modern uses of computers in today's life with examples. (08)

- (i) Internet of Things
- (ii) Cloud Computing

**Q.5** What is CPU instruction? Describe three types of CPU instructions with examples. (08)

**Q.6** What is network topology? Write down two advantages and one disadvantage of Star and bus topologies. (08)

**Q.7** What is database model? Explain three types of database model. (08)



**BALUCHISTAN BOARD OF INTERMEDIATE & SECONDARY EDUCATION****INTERMEDIATE (ANNUAL) EXAMINATION, 2021**

TIME: 3 HOURS

**SUBJECT:- COMPUTER SCIENCE - A**

MARKS 75

(NEW COURSE نیا کورس)

PASS MARKS:- 25

**SECTION-A**

Q.no.1 (a) Fill in the blanks. (6)

- I. LCD abbreviated as \_\_\_\_\_
- II. Wireless Fidelity system uses \_\_\_\_\_ waves.
- III. The Physical Component of Computers are called \_\_\_\_\_
- IV. One G.B is equivalent of \_\_\_\_\_
- V. CISC Stands for \_\_\_\_\_
- VI. TCP/IP consists of \_\_\_\_\_ layers.

(b) Choose correct answer forms the following.

(5\*2=10)

- I. What is HTTP?
  - (a) Markup Language (b) Protocol for mobile phones (c) WAP (d) TCP
- II. Which one has range of 40 to 50 km?
  - (a) Wi-fi (b) Wi-max (c) blue-tooth (d) Infra-Red
- III. Which layer of OSI model decides Physical path-way that data should take to reach out destination?
  - (a) Data link Layer (b) Network Layer (c) Presentation Layer (d) Session layer
- IV. Which part off computer decodes instruction?
  - (a) Mother board (b) Ports (c) Network Cards (d) cables
- V. Which part of computer decodes instructions?
  - (a) ALU (b) Main Memory (c) Program Counter (d) Control Unit

**SECTION-B**

Q.no.2 Write short answers of the following. (Attempt any seven). (35)

- a) Micro-Computers.
- b) Cloud-Computing.
- c) Cache Memory.
- d) ALU.
- e) Serial-Port
- f) Hub
- g) LAN (Local Area Network).
- h) Wireless Access Point.
- i) Address Bus.
- j) EEPROM.

**SECTION-C**

Note: Attempt any three questions. All questions carry equal marks (24)

- Q.No.3 What is guided media? Explain Different types of guided media. (8)
- Q.No.4 Describe Advantages & Disadvantages of Wireless Network. (8)
- Q.No.5 What is TCP/IP? Briefly explain four layers of TCP/IP. (8)
- Q.No.6 What are Out-put devices? Explain in detail. (8)
- Q.No.7 Write note on any three of the following. (8)

- (a) Serial Port (b) USB-Port (c) Fire-Wire port (d) HDMI Port

\*\*\*THE END\*\*\*

"Computers are incredibly fast, accurate and stupid;  
humans are incredibly slow, inaccurate and brilliant;  
together they are powerful beyond imagination."

Albert Einstein.

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